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ADDRESS AT THE ANNUAL GENERAL MEETING

of the Society, held on 22 June 1942, by the President

THE RIGHT HON. SIR GEORGE CLERK

DURING this last year the Society suffered a heavy loss in the death of its Honorary President, H.R.H. the Duke of Connaught. His Royal Highness had held that office for thirty years and his death was a heavy blow to the Society, but I am happy to say that the, if I may use the expression, lifelong connection between our Royal Family and the Society has been maintained unbroken, for H.R.H. the Duke of Kent has graciously consented to succeed the Duke of Connaught as our Honorary President. I am sure that His Royal Highness will continue that active interest and invaluable support which we always received from his lamented predecessor the Duke of Connaught.

There are other losses of eminent and distinguished Fellows and Honorary Members that we have to regret during the past year.

Dr. Heinrich Dübi, of Bern, one of our Honorary Members, who died early this year at the great age of ninety-three, was in his younger days an enthusiastic climber, and later an acknowledged authority on the early history of Alpine mountaineering, and a friend of Whymper, Freshfield, and Coolidge. He rendered valuable service also to mountaineering through his long service as editor of the *Jahrbuch* of the Swiss Alpine Club. He was elected an Honorary Fellow of the Society in 1916.

Dr. John Ball was awarded the Victoria Medal in 1926. It is difficult in a few words to do justice to Dr. Ball's scientific achievements in advancing geographical and geological knowledge of Egypt and Libya, culminating in his work as Director of Desert Surveys from 1919 to 1932. His long and valuable paper on "Problems of the Libyan Desert," published in our *Journal*, is recognized as a landmark in the study of Northern Africa. His inventive genius and long experience as a desert traveller also enabled him to make important contributions to the technique of topographical surveying.

Lord Rennell of Rodd had been a Fellow of the Society since 1894. The long family connection with geography, dating from the days of Major James Rennell, is maintained by Lord Rennell's son, well known for his travels among the Tuareg.

Lord Stonehaven, who was Governor-General of the Commonwealth of

Australia from 1925 to 1930, was not, I believe, ever a member of our Council, but he was in every sense a most representative Fellow of the Society: an intelligent and observant traveller with a genuine interest in the countries he visited and the peoples whom he found there. Such men as he are a great loss to our membership.

Another outstanding figure, who was a frequent attendant at our Meetings and took great pride in his membership of our Society, was the Maharajadhiraja Bahadur of Burdwan.

Sir Arthur Hill, who was killed by a riding accident in Richmond Park, was the Director of the Royal Botanic Gardens at Kew and had travelled widely as a botanist. I remember a very great many years ago finding myself in his company, and very delightful company it was, on a visit he was making to the West Indies on behalf of the Royal Botanic Gardens, whose support, given to many botanical expeditions, has often made valuable contributions to the extension of geographical knowledge.

Colonel Claude H. Birdseye was a distinguished member of the United States Geological Survey, and had carried out important topographical surveys, notably of the Grand Canyon. His contributions to geography were recognized in his own country by his election as President of the Association of American Geographers in the last year of his life.

Colonel Maurice O'Connor Tandy, R.E., spent most of his service as an officer of the Survey of India, eventually becoming a Director. On his retirement he was for thirteen years instructor in survey at Oxford.

Commander Louis Bernacchi, R.N.V.R., who had been a member of Council in 1929–31, had served as physicist on Borchgrevink's Antarctic expedition in 1898 and on the *Discovery* expedition under Captain Scott in 1901–3. He maintained a lifelong interest in Polar research, organizing a Polar Exhibition in London and assisting in the foundation of the Antarctic Club.

Dr. J. S. Owens gave many years' service as a member of the Research Committee, and himself contributed technical papers to the Afternoon Meetings, on subjects connected with the transport and deposition of solids by sea-currents, and river gauging. In his later years he did pioneer work in the study of atmospheric pollution and smoke-abatement.

Admiral Sir Cyril Fuller was for some years a member of the Council, where his experience and advice were much appreciated.

And perhaps it would not be out of place to regret the loss of one who, though he died as an enemy and a prisoner in our hands, was an enthusiastic geographer. The Duke d'Aosta could certainly be claimed as a member of the international brotherhood of geographers, and it might have been hoped that, when the war was over, he had many years before him in which to help the scientific advance of geography.

As you will see in the Annual Report for 1941, which is in your hands, no further structural damage has been done to the Society's House since October 1940, but in other respects the war has pressed hardly on our Society, as it does on every other institution and individual in this country.

The three points where we feel the pressure of the war most directly are:

Firstly, the diminution of our staff owing to the claims of military service. Not for a moment do we grudge this loss, and our best wishes go with those members of our staff who are serving their country in other fields, but it does

put a heavy strain on those who are carrying on the work here and the Society owes them a debt of gratitude for the way in which, one and all, they have faced up to the task, often at risk to their own health. For instance, the absence to-day of Mr. Hinks, the Secretary of the Society, is because he went on working when he should have been in hospital. Happily the operation has been most successful and we hope to see him back here very soon, completely restored to health.

Then, as you will see from the Report, the war continues to affect adversely our numbers, but it is encouraging to note that the total decline was less than in the previous year, and that the number of elections was slightly greater. The Council appeals with confidence to the Fellows of the Society to do their best to gain as wide support as possible for the work of the Society in these critical times, by securing new Fellows or by contributing to the general funds. We have recently received from Miss M. E. Vere Cust a generous gift to mark the fiftieth anniversary of her election as a Fellow. This has been allotted to the Expeditions Fund, which is being maintained in anticipation of the resumption of exploration after the war. To her, and to other donors, the Council have expressed their thanks.

And, lastly, as regards our meetings, we find ourselves living increasingly, if I may so put it, from hand to mouth. We can never be sure that the giver of the next week's lecture may not suddenly find himself ordered to some unknown destination, and another lecturer have to be found at a moment's notice: no easy task in these days when the claims of national service have scattered our Fellows all over the country and abroad.

I think therefore that we as a Society may congratulate ourselves that through the third year of war we have been able to complete a full programme of meetings, at which larger audiences have been present. The papers have ranged over wide and varied interests, and many have dealt with countries prominent in present-day affairs.

Dr. G. H. C. Hart, a distinguished Netherlands official, gave us a valuable and detailed paper on the issues at stake in the Netherlands-Indies. The presence of Canadian officers in this country has enabled us to learn at first hand of geographical and technical progress in the Dominion, and we are indebted to Lieut. L. G. Trorey and Captain G. S. Andrews, of the Royal Canadian Engineers, for valuable papers on photographic survey by high obliques, and on the Alaska highway route. Sir John Russell's account of reconstruction in Eastern Poland will surely be of value when that work is again taken in hand. Other important contributions have been presented by Sir Malcolm Watson, on the geographical aspects of malaria, and by Sir Henry Craw on the Burma Road. Representatives from many associations took part in a discussion of the geographical basis of regional planning, an aspect of the problem which requires close attention.

As my predecessor, Field-Marshal Sir Philip Chetwode, pointed out last year, systematic geographical exploration has of necessity been suspended, but this does not imply that the growth of geographical knowledge has ceased, and we may look forward in the future to having presented to us the results of much travel in, and acquaintance with, the lesser known areas of the world. The work of desert travellers in the Libyan campaigns is now well known, and elsewhere younger travellers are turning their peace-time

experience to good advantage. I may mention for example Mr. Eric Shipton, well known for his explorations in the Himalaya and the Karakoram, who is now serving as H.M. Consul-General in Kashgar. Incidentally, we must congratulate another of our younger explorers, Commander R. E. D. Ryder, R.N., Captain of the *Penola* on the British Graham Land Expedition, on the award of the Victoria Cross for his valour at Saint Nazaire. We may be confident that throughout the world many of our Fellows are using their experience for the advancement of the national effort. To those in enemy hands in Singapore, the Far East, and elsewhere, we extend our sincere sympathy, and wish them a speedy end to their present trials. At home also geographers have their contribution to make, as the importance of our science gains wider recognition.

Indeed I think that we shall find that this war has formed a sort of bridge between the pursuit of geography as it was when our Society was founded, and the form which the development of geographical knowledge is imposing upon it. When our Society was founded there were vast tracts of the Earth's surface in Africa, Central Asia, South America, and the polar regions, which were quite unknown, and knowledge about them was only obtained at great risk and through enduring great hardships. We can proudly claim that by its encouragement of explorations in these unknown regions, and by its welcome to those explorers who brought back to us such valuable additions to our knowledge of the Earth, our Society acquired a position in the world of geographical science which has more than justified the hopes of its founders. But great exploration, in the sense of first discovery, is now almost finished. There is scarcely a square mile of the Earth's surface which, even if it has not been trodden by the foot of the explorer, has not been seen from the air. But that does not mean that exploration is finished: it has only changed its character and in future will be intensive rather than extensive. The broad outlines drawn by the pioneers will be supplemented in detail by the explorers of the future. This is a work which has always distinguished our Society and a work which we intend to prosecute as vigorously as possible when life becomes normal again. So far as our means allow, we shall continue to train explorers in surveying, equip them with instruments, advise them on equipment, give them the facilities for research furnished by our Library and Map Room, and, where and when it is possible, give such financial assistance as we can. But this is not enough. As the science of geography develops, it comes more and more into relation with other branches of knowledge, and one of our functions is to collect and compare the results obtained by explorers and bring them into harmony with general scientific knowledge. Moreover, the development of the film and of aerial photography has opened up a field where the dry bones of geographical facts can be clothed with the beauties that until a few years ago only the explorer saw. I need not emphasize the added interest which is thereby given to our lectures, for we have all experienced it. I only venture to make these few observations in order to bring it home to your minds that the Society will to the best of its power and its resources maintain and advance in every way possible the development of geographical science and keep up its traditional position as a leader in that great sphere of human thought and endeavour. I am confident that in this aim we may count on the active help and support of every Fellow of the Society.

ALASKA HIGHWAY SURVEY IN BRITISH COLUMBIA

CAPTAIN G. S. ANDREWS, R.C.E.

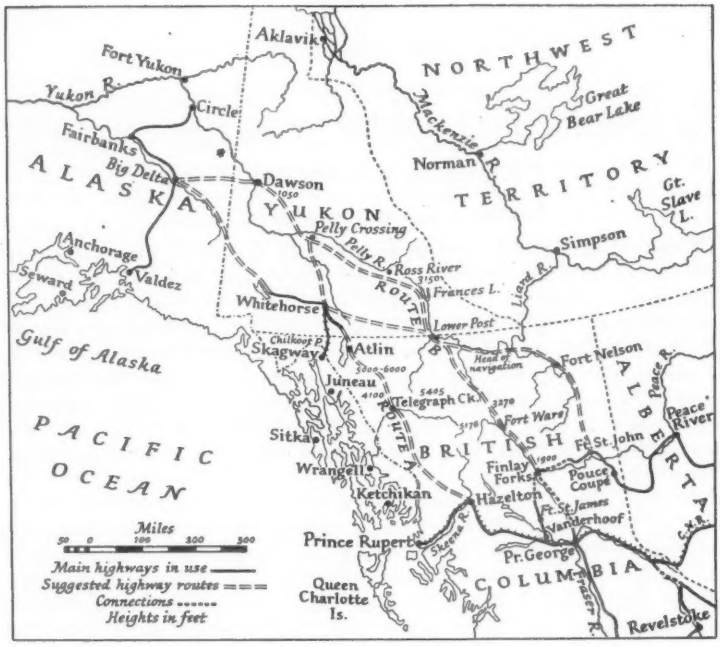
Meeting of the Society, 2 March 1942

THE Alaska highway project is a modern episode in the conquest of America's Great Northwest which began four centuries ago when Champlain searched the St. Lawrence river for a waterway to China. The last stronghold of the Great Northwest includes the northern portions of British Columbia and Alberta, the Yukon Territory, and Alaska. Access to it is chiefly from scattered points along the Alaska coast which must first be reached by sea. Air mail and wireless have mitigated the isolation of pioneer communities in parts of the region, but immense potentialities for industry and settlement still wait for a land connection with the great highroads of North America.

In 1793, Alexander Mackenzie reached the Pacific shores near Bella Coola (lat. 52° 20′), overland from Montreal, crossing the Rocky Mountains by ascent of the Peace river. First to cross the continent north of Mexico, he was the vanguard of the fur traders, who during the next seventy years followed all the main rivers of this region. Discovery of gold on the Fraser river in 1857 attracted a migration of forty-niners from California, which after temporary occupation in the Cariboo, continued northward into the Omineca and Cassiar districts of northern British Columbia, and culminated in the Klondike rush of 1897. The "front door" to the Klondike over Chilkoot pass from Skagway, guarded by the R.C.N.W. Mounted Police, was open only to those who had a $1000 grub-stake. The poor man's trail or the "tradesman's entrance" was for some the overland journey along routes considered for the Alaska highway, and for others the long river trip *via* the Mackenzie and the Liard.

In 1865 the Western Union began surveys for a telegraph line to connect America with Europe, *via* Alaska and Siberia, but withdrew when the Atlantic cable was successfully laid in 1868. The year before, Russia sold her interests in north-west America to the United States. Schemes for a railroad following the general route of the telegraph line were abandoned because of war between Russia and Japan in 1904. However the practicability of the railroad, including a tunnel under Bering strait, had received a favourable verdict from engineers. The development of the automobile about this time was to inspire the next and most determined of all schemes to open up the Great Northwest by a system of modern highways. The project was officially recognized in the United States in 1929 and soon after received cooperation from Canada. Subsequent depression years caused a temporary setback until 1938–39.

An Alaska highway would serve a threefold purpose: economic, recreational, and military. Natural resources of the region in minerals, furs, and water power are known to be very great, and there is sufficient timber for local requirements. Under present conditions of transport they remain little more than frozen assets; to tourists and sportsmen the country will always



Comparative distances, in statute miles, by ground routes from Prince George

Existing roads
Railways
River routes
Proposed roads
Connections

Vancouver 526
Chicago 2155
New York 3046
Seattle 634
San Francisco 1600

make a strong appeal. The military significance of the road now takes precedence, due to the key position of Alaska in the north Pacific. Notoriously fickle weather with foggy tendencies, a mountainous and intricate shore line make air connections between coastal bases, themselves susceptible to attack, uncertain and inadequate.

Choice of route

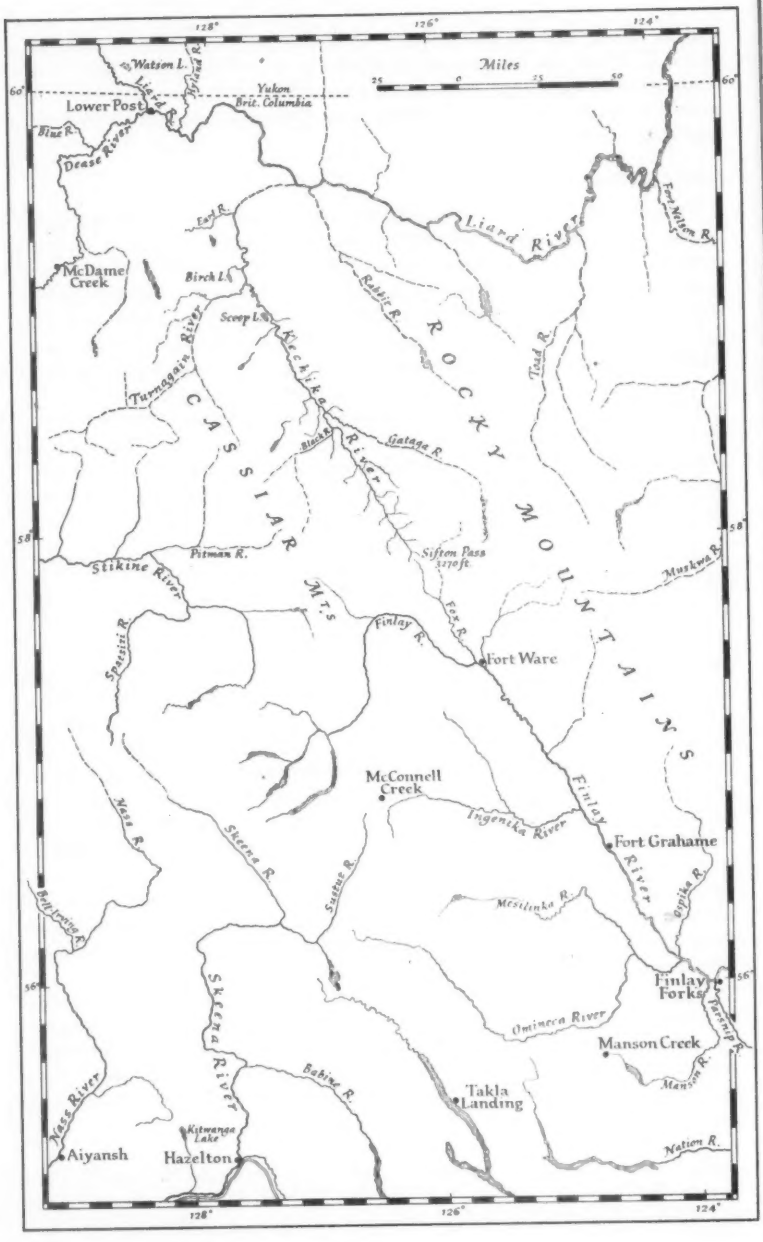
Topographic factors alone preclude any thought of a road along the coastal side of the rugged and partly submerged Cascade mountains. A route must be selected somewhere on the interior plateau to the east. What is now a modernized version of the old Cariboo road, built by the Royal Engineers during the Fraser river gold rush in the 60's, ties in with the continental road network near Kamloops and leads north to Prince George on the trans-continental railway. From this jumping-off point a cursory knowledge of geographic conditions has led to conceptions of two distinct routes.

The western route, A, would utilize about 300 miles of second-class unsurfaced road from Prince George to Hazelton, thence across to the Nass river *via* Kitwanga lake, up the Nass and Bell-Irving, crossing over to and following up the Iskut, over a 3300-foot pass and down to the Stikine, up the Tuya, thence to Atlin, Whitehorse, Pelly Crossing, Dawson, and west into Alaska to join the existing Valdez–Fairbanks road.

The eastern route, B, would head northerly from Prince George to the great intermontane valley known as the Rocky Mountain Trench. This is a U-shaped trough extending almost 1000 miles across British Columbia from the Montana boundary north-westerly to Yukon Territory. It is one of the most striking orographic features of the province, flanked on the north-east by the Rocky Mountains, and on the south-west successively by the Selkirk, Cariboo, and Cassiar mountains. The floor, varying from 5 to 15 miles in width, is drained in turn by the Kootenay, Columbia, Fraser, Parsnip, Finlay, and Kechika rivers. In the south it is busily occupied by lumbering, mining, and farming communities, with main rail and road connections favoured by easy grades and well-drained terraces. The B route for the Alaska road would follow the unsettled northern part of the trench in a remarkably straight line to the junction of the Dease and Liard rivers at Lower Post. From there it would enter the Yukon Territory following up the Liard and Frances rivers, cross the divide to descend the Pelly, and join route A at Pelly Crossing. The highest elevations along this route are 3270 feet on Sifton pass and 3150 feet on the Frances–Pelly divide.

Several variations between these two routes have been proposed, all having to cross at least one summit of over 5000 feet. The chart gives comparative distances on the two main routes, and shows several strategic connections relevant to each and to the terminals. The figures give estimated route distances in statute miles, and although approximate the relative proportions are fairly accurate.

The main advantage of the western route is its proximity for branch connections to the west coast which would serve several important centres along the Alaska panhandle, especially Wrangell and Juneau. This advantage has


128°
126°
124°
60°
58°
Miles
25 0 25 50
Watson L.
Liard R.
Yukon
Brit. Columbia
Lower Post
Blue R.
Dease River
Toad R.
Fort Nelson R.
Liard River
Dall R.
McDame Creek
Birch L.
Rabbit R.
ROCKY MOUNTAINS
Sheep L.
Kechika R.
Tuttle R.
Turnagain River
CASSIAR MTS
Gataga R.
Stikine River
Pitman R.
Sifton Pass 3270 ft.
Muskwa R.
Finlay R.
Fort R.
Fort Ware
Spatsizi R.
McConnell Creek
Ingenika River
Finlay River
Fort Grahame
Nass R.
Skeena R.
Sustut R.
Misstinka R.
Bell-Irving R.
Omineca River
Finlay Forks
Parsnip R.
Manson Creek
Manson R.
Takla Landing
Babine R.
Skeena River
Nass River
Kitwanga Lake
Aiyansh
Hazelton
Nation R.

naturally been emphasized by members of the American commission. The chief disadvantages of the western route are climatic and topographic. Heavy snow throughout most of the route increases maintenance and shortens the open snow-free season. In general, construction costs would be greater than on the eastern route. It is said that the cost of branch roads through the mountains to the coast would exceed the cost of the main trunk road. Its proximity to the coast and indeed any connecting roads would render it more open to hostile action from the Pacific.

Outstanding advantages of the eastern route are light snowfall and easy construction. Surveyors report average depth of winter snow from 18 inches on the floor of the Rocky Mountain Trench, to 4 feet on Sifton pass. This would lengthen the snow-free season one or two months and reduce year-round maintenance. The broad U-shaped trench carrying the road for 500 miles in a straight line is a gift for the road builder. Economically, this route would offer a western outlet for the famous Peace river farming country by a 50-mile connection down the Peace river from Finlay Forks. Again, at the Liard river a branch road 150 miles downstream would connect the head of navigation on the Mackenzie river system, opening six weeks earlier each year than the present route through Great Slave lake. From the mining standpoint it is significant that along the Trench a road would follow closely for 400 miles the line of contact between the Rocky Mountain sedimentaries on the east and the eruptives of the great Omineca batholith to the west. Military advantages of the eastern route are important. It is far enough inland, behind two mountain ranges to be relatively immune from air attack, and the flat cross-section of the Trench floor offers admirable sites for aerodromes and easy diversion in case of enemy action on the road itself.

British Columbia Survey

Detailed treatment of the interesting survey history of the Great Northwest is outside the scope of this paper. Sir Alexander Mackenzie entered the Rocky Mountain Trench *via* the Peace river, and passing the mouth of Finlay's branch on 31 May 1793, ascended the Parsnip. In 1887 Dawson traversed the Liard and set a monument near its crossing of the 60th parallel, the boundary between B.C. and the Yukon. Ten years later Inspector J. D. Moodie of the Northwest Mounted Police reconnoitred for a wagon road *via* the Trench to the Yukon, wintering at the Hudson Bay Company's Fort Grahame (established 1869). Shortly afterwards the boundary between the Alaska panhandle and B.C. was surveyed. In 1907 the B.C. government published the first detail map of the Northern Interior, scale 10 miles per inch, from surveys of the late Father A. G. Morice, O.M.I., this remarkable document covered mainly the lake region tributary to the Nechako and Skeena rivers. Between 1912 and 1939 Frank Swannell made exploratory and triangulation surveys in the Nechako, Skeena, and Finlay watersheds, and in his report of 1939 to the Surveyor-General gives an excellent treatment of the Rocky Mountain Trench as far as Sifton pass. Triangulation nets have been extended up the Skeena, Nass, and Iskut to Dease lake mining area.

Before the development of modern air survey methods, surveys were unable to keep pace with the development of new country. Resulting errors in

administration have been costly to the individual and the community. Because of the speed and efficiency of air photographic technique, a survey of the vast and difficult country in advance of location and construction of the Alaska highway has been possible.

In 1929 and 1930 the first extensive air survey in British Columbia included the Parsnip river section of the Trench and the country to the east but south of the Peace river. This was a natural resources survey including triangulation, topography, forest, and soils in connection with a proposed extension of the Pacific Great Eastern Railway into the Peace river district. The quality of photographs and methods of compilation were somewhat elementary in view of later developments, but that project was a record for its day in the amount of country covered, the detail of maps and other information secured, and the time taken to complete it. During the following years a successful method of combining vertical air photographs and ground survey photographs of rugged country for large-scale detailed contour mapping was developed and widely applied by surveyors of the Phototopographic Division of the B.C. Survey Branch. During the same period the application of air photographs to natural resources surveys, especially forestry and land classification was energetically exploited by the B.C. Forest Service. In all this activity thousands of vertical air photographs taken by the R.C.A.F. were utilized.

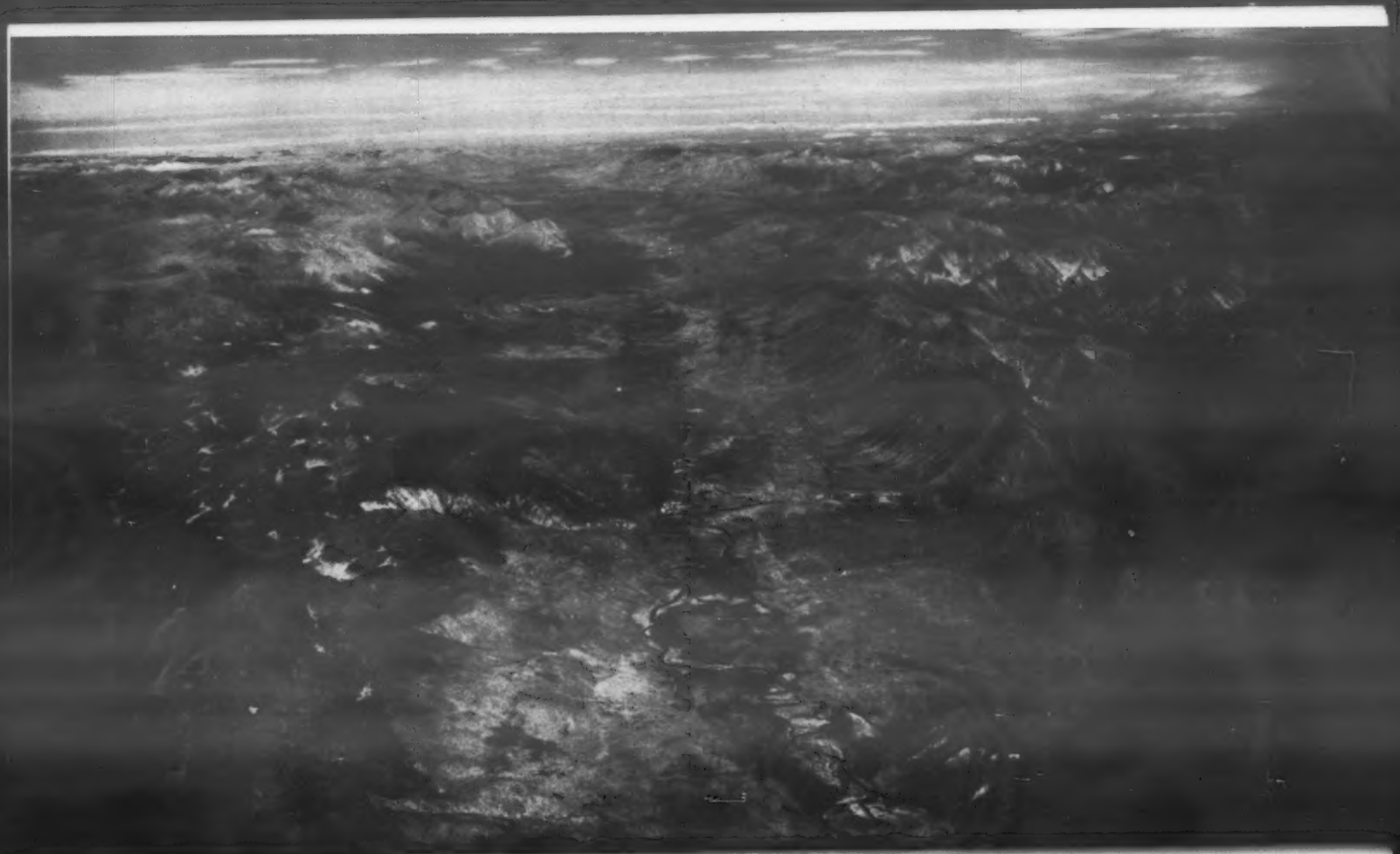
Owing to the restriction of Air Force activities in B.C. during the depression years after 1931, the Forest Service in 1936 began to do its own photographic flying, with modern air camera equipment purchased in England, and adapted aircraft chartered for each season under direction of government engineers. By the end of 1940, after five successful seasons, tracts in all parts of the province totalling some 22,000 square miles had been covered with vertical survey photography suitable for mapping on a scale of 1/31,680. This was exclusive of other areas done by the R.C.A.F. for national defence purposes. Thus the British Columbia government was in a strong position technically and materially to embark on detail surveys for the new road to Alaska.

After a close study of all available data, including reports of commissioners who had made visual reconnaissance of the territory by air, the provincial government in 1939 decided to proceed with an intensive survey of the Rocky Mountain Trench route, considering it the most likely to be finally chosen.

Survey of the Rocky Mountain Trench 1939–41

The aim was to produce an accurate detailed topographic map of the Trench from Finlay Forks to the northern boundary of the province where the Liard river enters from Yukon Territory, at a scale of 1/31,680 with 100-foot contour interval. This comprised a tract approximately 350 miles long by 10 miles wide to include the floor of the intermontane trench, the declivities and summits of the immediately adjacent mountains. The tract was to broaden out somewhat at the north end, where the mountains fall back to east and west, giving way to a broad glaciated basin. Provision was made by the Public Works Department for detailed examination by road engineers for bridge sites, soil, drainage, and timber conditions.

1. Rocky Mountain Trench looking south-east over Sifton pass



Supply and communication for ten separate survey parties strung out in the long narrow tract was a big problem. All but two parties went into their areas and were supplied from Prince George. This involved transport by shallow-draft river boats, powered by outboard motors, downstream *via* the Crooked and Parsnip rivers to Finlay Forks, then the long pull up the Finlay, through Deserters' canyon to Fort Ware, an air-line distance of 240 miles, but the meandering of these rivers over the wide floor of the Trench increased this to about 350 travel miles. Credit is due to those who had the contract for freighting. The initial voyage with the parties and subsequent monthly round trips with supplies were made punctually on schedule without loss of a single package. Many drums of aviation petrol were moved in the same way and cached at Finlay Forks and Fort Ware. At the latter point supplies still to go forward were transferred from boats to horses, proceeding by pack trail 50 miles to Sifton pass, and 50 miles down the Kechika to the Gataga river. From there it was another 50 miles to the vicinity of the Turnagain river, the ultimate point reached by the second triangulation party from the south.

The two northern parties reached their starting-point, Lower Post (Liard) by coastal steamer 580 miles from Vancouver to Wrangell, by stern-wheeler 140 miles up the Stikine to Telegraph Creek, then by rough wagon road 73 miles to Dease lake, down it and Dease river to the Liard, another 130 miles by boat. Aviation petrol went in this way too in anticipation of survey flying from Lower Post. From the Liard across the rolling basin to the Turnagain is about 70 miles by trail.

It will be seen that the movement of men, equipment, and supplies was arduous, expensive, and except for the outboard motor, little less primitive than conditions one hundred years ago. Two modern items distinguished the field activities: one was a fortnightly air mail service from Prince George to Fort Ware, the other was the use of small portable wireless telephone sets, developed and supplied by the Forest Service, one to each of the phototopographic and one to Pattinson's triangulation party. To conserve batteries nightly schedules on a single short-wave band were maintained up and down the Trench. This did a great deal for coordination between parties within the area, and between the whole operation and headquarters in Victoria *via* the powerful Forest Service radio station at Prince George. Connections were also maintained between the photographic aircraft and the field sets and to Fort St. James, a permanent air base. The Hudson Bay Company and Government Telephone also have wireless telegraph stations at Finlay Forks, Fort Grahame, Fort Ware, Lower Post, and Dease lake.

Triangulation control: The Ingenika base, $2^1/_4$ miles long, established by Cokely and Swannell in 1930, was the starting-point for the triangulation net which was extended during 1939 over Sifton pass almost to the confluence of the Turnagain and Kechika rivers (just under 200 air miles). Some forty-nine primary stations were set and occupied in this chain, and secondary stations dispersed by the topographic parties were cut in. The adaptability of the country along the Trench to triangulation may be appreciated from the photographs. Although overcast skies were prevalent during the 1939 season, visibility was generally reported good. The party under Moncton working

. Rocky Mountain Trench looking north-west from Sifton pass

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3. Looking north-east over confluence of Gataga and upper Kechika

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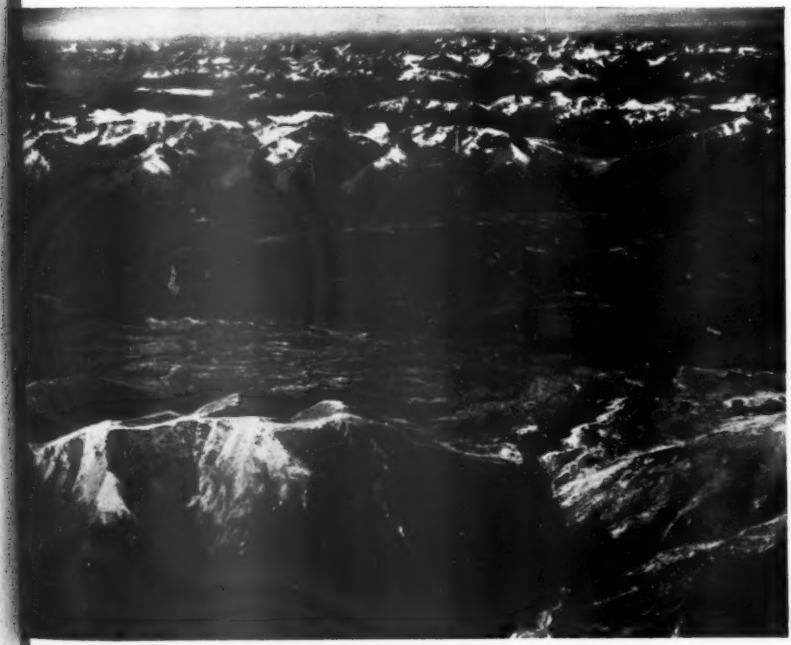

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it is necessary to proceed with an alternative programme, due to clouds interfering with the original plans.

Approaching the start, in line of the first strip, checks on drift, interval, and light are made with consequent adjustments. The photographic flight log is clocked for start and end of each strip with entries for altimeter, temperature, exposure, and haze. Intermediate entries are made according to opportunity. A synchronized watch in the camera recording on each negative, correlates these data with the photographs. The pilot's job is to keep the aircraft on a steady course, on an even keel, and at a constant altitude. The observer, free to move about, checks the line made good by identifying landmarks in the view finder, informs the pilot of deviations from course, watches the altimeter, and sketches onto the flight map any conspicuous landmarks for controlling adjacent strips, and otherwise maintains liaison between pilot and camera operator. The latter watches exposure interval which varies with topography; head and tail winds; light meter; camera level; drift, and progress of the film in the magazine. He must be able to change magazines within the exposure interval so that the sequence of exposures in a strip is unbroken. During end-turns he inspects the shutter action by removing the magazine. Another of his tasks is to keep the flight log.

The routine goes on, ploughing photographic furrows up and down the sky at 16,000 feet, 30–40 miles long and about 2 miles apart, requiring sustained and intense concentration on the part of the crew, with only a few moments' relaxation at the end turns, until the clock warns that there is only enough fuel to make the long gliding descent back to base. Time distribution averages: ascent forty to fifty minutes, photography almost four hours, descent fifteen minutes, totalling about five hours off the ground. If possible the flight is timed for photography to bracket local mean noon, for maximum light and minimum shadow. Frequently morning fog or clouds delay take-off, in which case photography may continue till 4 p.m. About this time mountains to the west begin to throw long shadows across the terrain, obliterating important detail.

It has been our experience that gaps in the photo-coverage are detected as soon as the offending strip is completed from the observer's running check on course, and in such cases a short run is made immediately to cover the gap. In this way gaps are closed when the aircraft is on the spot, and navigation conditions are best known. For this reason alone the observer more than earns his keep as a member of the crew.

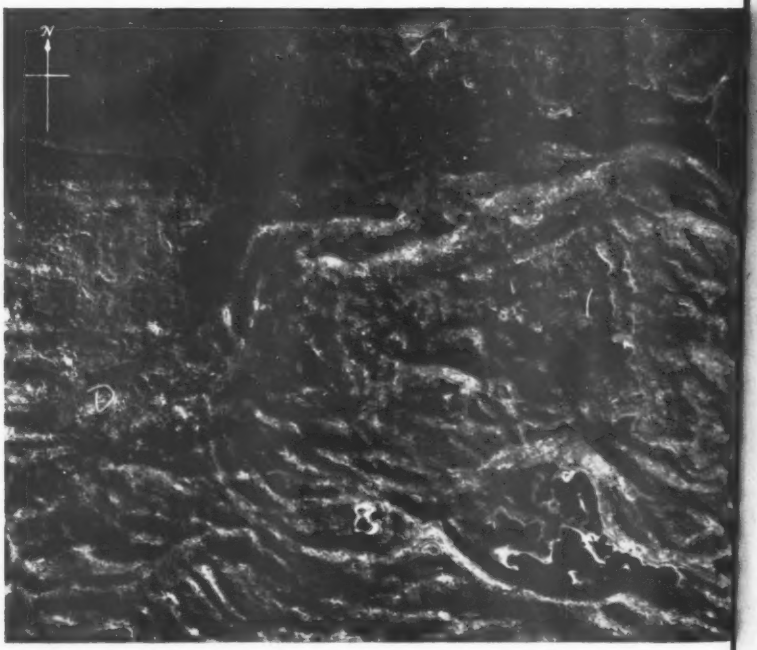
The photographic strips were laid out in advance on specially drawn maps of ½ inch scale of the whole Trench, whose length was divided into blocks from 30 to 40 miles long, at points where good transverse detail could be found. Thirty-mile strips were quite practicable from the photo-navigation standpoint, but the economic advantage of longer strips is seriously compromised by increasing difficulty to maintain the course laid down, due to the over-burden on memory of incidental landmarks for controlling the adjacent return strips, and to the fact that fatigue and inefficiency mount rapidly if the brief relaxation of the end turn is postponed too long.

From Finlay Forks it took about ten calendar days to complete the work to the Ingenika river, comprising two 35-mile blocks. In this time the

7. Aircraft at Lower Post

8. Sifton pass

9. Looking north-easterly across upper Liard basin



10. Moraine deposits in upper Liard basin

weather provided not more than two-and-a-half photographic days, and it became evident that a move to Fort Ware was necessary for further operations. From there we could work both up and down the Trench, a more strategic position operationally and for keeping an eye on the weather. Take-off conditions for the heavily loaded aircraft on the river were none too good, as the straight run was barely long enough and air conditions were often turbulent due to a prevalent wind from the Peace river gorge through the Rockies meeting with strong air currents moving up and down the Trench. We were told that this "Peace river wind" blows with great bitterness and strength in winter.

Take-off conditions at Fort Ware were even worse for our purpose than at Finlay Forks, owing to the rapid current, a rather short run, and an obstruction at the lower end in the form of a high timbered bluff. A point some 8 miles down river was selected for our No. 2 base, where there was a long straight leg of water free from topographic interference at either end, with moderate current to allow take-off upstream if the wind so required. There we found good mooring for the aircraft, shelter, and firewood on a timbered high-water island. Using a Finlay river boat and "kicker" belonging to Swannell's triangulation party, who were at this time away up the Fox river with pack-horses, we maintained a rainy-day ferry service on the 8-mile stretch to Fort Ware, bringing down three or four drums of aviation petrol each trip from our cache there. The weather decreed that this base on "KP Bar," our island was christened after the call letters of the plane, CF-BKP, was to be our headquarters for almost six weeks.

The life of an air survey field detachment has its ups and downs. Each member must be highly trained, and by nature active and enterprising. To have to stand by day after day waiting for clouds to move away, having all the equipment in perfect readiness for action, and waiting alert each day till early afternoon in case at the last minute the skies might clear, which they often do at night-time, is a strain indeed. Suddenly comes a sequence of photographic days—intense activity demanding a high pitch of nervous concentration, physical endurance, and team work. The air surveyor's catechism decrees that not one bit of photographic weather be wasted during the short season. At the end of the 1939 season the air survey detachment had the satisfaction of knowing that every photographic day had been effectively utilized, and during the long waits between, good fellowship and harmony prevailed.

From KP Bar vertical photography was completed as far as Sifton pass, and partially down the Kechika almost to the Turnagain, but not progressively, because cloud often interrupted the work forcing sporadic strips to be flown farther afield where it might be clear. Owing to the advanced state of the season it was evident that weather probabilities were not good for completing the vertical photography to the Liard that year. So it was decided that at the first opportunity should be used to take obliques along that stretch for securing sufficient photographic data to assist the ground parties the next season, and to enable a small-scale map to be prepared for subsequent flying. The existing maps north of Sifton pass were known to be shaky, having been compiled from Moodie's exploratory notes of 1897.

On August 28, a cloudy day in the Finlay, Pattinson reported by wireless that mists were clearing near the Gataga, and that weather looked even better to the north-west. It was then noon, but we took off immediately, with the camera slung for obliques, and by the time Sifton pass was reached we had enough altitude to start shooting. By now the sun was in the south-west, so the camera was directed north-east over the Rockies, and a course was followed to include the floor of the Trench in the foreground of the pictures. The camera axis was depressed about 20° to give a good horizon image without excess of sky.

The Trench, well defined as far as the Turnagain river, served as a conspicuous guide for the flight that far. Beyond this point the river swings north-east to join the Liard. The line of flight followed down the Trench from Sifton pass was continued north-westerly by compass over the wide glaciated upper Liard basin, on which there was a conspicuous pattern of drumlins aligned almost due east and west. After crossing the Dease river which was easily recognized, we circled at the Yukon boundary to record a radiating fan of views, before sliding down the air slope to Lower Post.

The wide basin seen from the end of this flight is indeed a meeting of waters, as at some future time it may well be for transportation arteries converging from a wide circumference. It is here that the Liard gathers up the strands of its own upper reaches: the Dease, the Turnagain, and Kechika, the Hyland, and the Frances rivers, and rolls eastward through a chain of canyons which marks what remains of the Rocky Mountain system, and on through the great plains of the north, to join the Mackenzie, at Simpson, 390 miles from Lower Post. After our long sojourn in the mountainous country to the south, the air view of the basin's expansive floor was impressive, and enabled us to appreciate the difficulties facing Moncton in carrying his triangulation net across it.

At Lower Post our petrol cache was found correct, and in the evening a reconnaissance was made by boat for take-off facilities, in the course of which the wreckage of another plane which earlier in the year had failed to clear a nearby timbered hillock was discovered, a grim reminder of the importance of carefully checking the lie of the land, river, and wind relationships for take-off. Next morning the sky was overcast, with indications of worse weather to follow. Vertical photography had not been completed south of Sifton pass, so it was decided to return immediately rather than become storm-bound on the Liard when photographic weather might prevail in the Finlay 200 miles away. It was disappointing to have to dead-head back, as we had hoped to take obliques to the south-west, with the morning sun in the south-east quadrant. The east–west alignment of the glacial pattern noticed the previous afternoon proved to be a most useful aid to navigation, as visibility over the basin was poor, and the compass was misbehaving. We were not to return to the Liard that year, having utilized the only photographic day in that region during the season.

One evening soon after the Liard flight we sat huddled around the ear phones of the aircraft wireless to hear it announce that war against Germany had been declared. On our lonely sandbar in the upper Finlay, so far from

the fateful events taking shape in Europe, we sat up late that night around the meditative flickers of our camp fire. Perhaps an intuition that our role there on the Finlay might eventually have a humble place in the grand strategy led to the decision to remain on the job till the end of September, to finish if possible the essential part of the season's programme. This aim was accomplished: complete vertical coverage to Sifton pass, and beyond partially to the Turnagain. In addition to the obliques taken on the Liard flight, we were able to obtain sequences both to north-east and to south-west for practically the full length of the Trench from Finlay Forks to the Turnagain. These were worked in on various occasions going to and returning from the vertical strips. The obliques comprised a valuable store of reconnaissance data covering not only the Trench proper, but a considerable belt of unexplored country flanking it on either side, which could be plotted on small scale, by Crone's graphical method, exterpolating from the solid control along the Trench. They added very little to the total cost of the photography, and justified the decision and effort to take them.

The end of September found the air survey detachment back in civilization, having done about 6900 square miles of vertical photography during the whole season. During the winter of 1939–40 in Victoria, the reduction of field notes and photographic data went on apace. As luck would have it, an overlapping pair of our oblique air photos in the Turnagain vicinity was used to make a temporary photogrammetric tie between the triangulation nets of Moncton and Pattinson. Flight profiles plotted from data in the photographic flight logs were found to agree closely with trigonometric checks and were of material help to the Phototopographic Division in stereoscopic contouring.

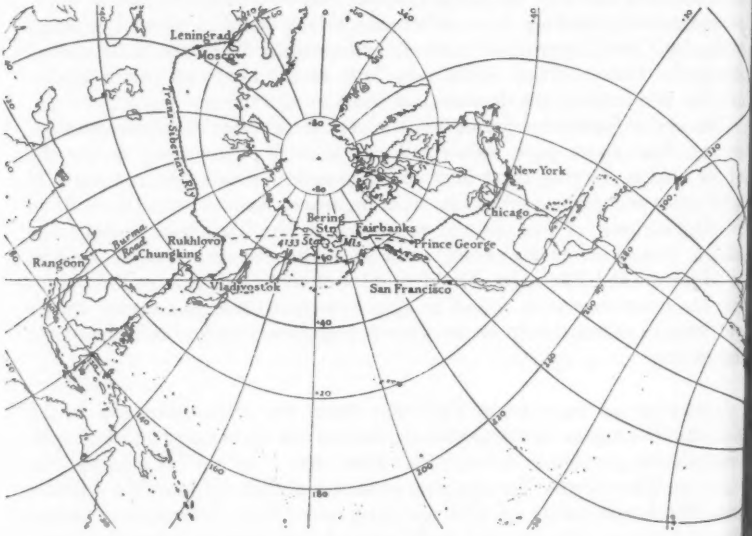
Next season a party under Pattinson closed the triangulation gap in the Kechika–Turnagain vicinity, and extended the net westward to interlock with triangulation previously brought to Dease lake from the Skeena, *via* the Nass and Iskut rivers. Topographic work was carried on down the Kechika from Sifton pass, for 50 miles by one party under N. C. Stewart, who during the 1941 season, with a second party under A. J. Campbell, completed topographic work on to the Liard. With the Air Survey Section's two senior and experienced engineers in the army overseas, the task of completing vertical air photography on the Kechika and upper Liard basin in 1940 fell to Benton, assistant engineer, who with the help of the pilot, Gendron, and Stewart acting as observer, completed this work in a very creditable manner indeed, operating from Lower Post on the Liard.

A Northwest Passage by land

The stimulus which initiated the conquest of the Great Northwest and which sustained it for three centuries was the hope of finding a north-west passage for sea trade with the Orient. The fallacy of this hope was finally proved by Alexander Mackenzie and Samuel Hearne, whose travels were really concerned with the wealth of the Occident. Providence denying easy riches from the East with one hand, with the other offered a new empire. To-day, in defending this empire and all that it means, we must revert

once more to the old quest of finding a way, this time by land to the Far East.

Because of the great distances, a study of routes between America and the Orient must follow the lines of great circle geography. Mr. Hinks's "Oblique Mercator" projection may be admirably adapted to delineate without appreciable distortion the entire Pacific periphery from Cape Horn to Singapore by inclining the pole of his central oblique great circle to lat. 35½°, and swinging it around to long. 02° E. This shows the impressive fact that the Pacific coasts of Asia and the Americas align themselves very closely along a great circle, a fact of fundamental, but otherwise not obvious strategic significance. If we draw the great circle from Prince George, B.C., to Rukhlovo, the nearest



point on the trans-Siberian railway, we find that the proposed Alaska highway is not far off it, and the Yukon river continues along it toward Bering strait, where it crosses to Asia and follows a course comfortably inland from the sea. The distance along this great circle between the terminals mentioned is approximately 4100 statute miles. Vancouver to Vladivostock by sea is about 5100. At the other end of this Pacific great circle we find the geometric as well as the strategic counterpart of the Alaska highway, the Burma Road, now denied us as an entrance to inside China. It is not inconceivable with modern road-building facilities, to project the proposed Alaska highway farther along the great circle for a cooperative thrust at Japan's none too secure rear.

Shortly after this paper was read to the Society on March 2, operations began on the construction of a military road to Alaska. A joint agreement between the U.S. and Canadian governments was announced on March

and next day the first contingent of U.S. Army Engineers entered Canada bound for the starting-point. Final terms governing the project were signed on March 18 by Mr. Mackenzie King on Canada's behalf. It provides that the section of road in Canadian territory will be built entirely by U.S. Army Engineers, who will bring in all their own equipment and supplies duty free. The U.S. government will bear the whole cost, estimated at seven to ten million pounds. They will also maintain the road until the end of the war.

To authorities who have made a special study of the Alaska highway problem during recent years, the route chosen under the new agreement came as a distinct surprise, since it is entirely new as far as the Yukon boundary. Instead of following a straight line in the Rocky Mountain Trench north-west from Prince George, it will follow an existing road from Edmonton, Alberta, to Fort St. John, B.C., on the Peace river. From there new construction will continue north *on the east side* of the Rockies to Fort Nelson, and then westerly up the Liard to Lower Post and Watson lake, whence it will proceed *via* Whitehorse. It is admitted that this route is based solely on "military necessity" to connect a chain of recently built aerodromes along the Alaska air route through Edmonton, one at Fort St. John, one at Fort Nelson, and one at Watson lake, near Lower Post. The aerodrome at Fort St. John is already connected by a 55-mile road to the terminus of a branch railway from Edmonton. The aerodrome at Watson lake would be more directly served by a road along the Rocky Mountain Trench. So the net advantage is mainly that the new road will connect Fort Nelson, which is at present served by air, by winter trail across frozen muskeg, and by summer navigation *via* waterways of the Mackenzie system.

Disadvantages of the Fort Nelson route are great. The distance from Edmonton to Watson lake, where a Trench road would pass, is 15 per cent. greater *via* Fort Nelson than *via* Prince George and the Trench. The terrain east of the Rockies presents a succession of rivers and muskegs athwart the path of the road. Grave difficulties in construction and maintenance must be anticipated when spring floods spread out from shallow river channels, and when summer heat thaws out the bottom of extensive muskegs. It is naturally disappointing to those who made the surveys of the Rocky Mountain Trench described above with complete coverage of air photographs, already compiled into accurate large-scale topographic maps, and specific road location data resulting from surveys by the B.C. government, to learn that this route, which seemed to offer such remarkable ease in construction, has been put aside, for what appears to be a veritable plunge into an unmapped wilderness of muskeg east of the Rockies.

NOTES ON THE ILLUSTRATIONS

The Society is indebted to the British Columbian Forest Service for permission to reproduce the air photographs. Copies of the photographs can be purchased from the Forest Service, Victoria, B.C., by quoting File 0130551 and the roll and film number. In the description, where it is necessary to locate a point, the distances in inches from the left hand and lower edge are given.

1. *Rocky Mountain Trench looking south-east over Sifton pass*

The meadows in the centre 4.1, 2.8, drain south-west from Sifton pass 3.9, 1.8, *via* the Fox river to the Finlay. In the left foreground the Kechika, reflecting the sun, flows north-west to join the Liard. The valley of the upper Finlay, above the entry of the river into the Rocky Mountain Trench can be seen in the background. The infra-red photograph was taken into the sun and brings out the troposphere in the form of the white line at the horizon. (Roll 65 Film 7.)

2. *Rocky Mountain Trench looking north-west from Sifton pass*

This infra-red photograph was taken from above Sifton pass looking north-west down the Kechika river. The Rocky Mountains are to the right, the Cassiar Mountains to the left, separated by the Rocky Mountain Trench. The sun in this photograph was behind the camera. (Roll 65 Film 5.)

3. *Looking north-east over confluence of Gataga and upper Kechika*

Plates 3 and 4 are taken from the same area but in opposite directions. Contrast the white water of the silt-laden Gataga flowing from the Rocky Mountains with the black clear water of the Kechika (bottom right) flowing from Sifton pass. Compare the Rocky Mountain sedimentaries with the eruptives of the Cassiar Mountains in Plate 4. The light colour of the ridges is not snow but a characteristic yellow shale. (Roll 188 Film 1.)

4. *Looking south-west over upper Kechika river*

The photograph was taken looking south-west over the trough of the upper Kechika river, which can be seen in the centre, with the Cassiar Mountains in the background. Geologically this range is part of the Omineca batholith. (Roll 192 Film 74.)

5. *Looking south-west at Fort Ware*

The Finlay river enters the Rocky Mountain Trench from the west through the gap in the right background. The Fox river draining the trench south from Sifton pass is the small stream coming in from the right on the far side of the trench 4.7, 2.0. The Kwadacha river is in the foreground. (Roll 194 Film 54.)

6. *Looking north-east over confluence of Kechika and Turnagain*

Clear water (black) of the Turnagain 2.5, 0.0, flowing from the Cassiar Mountains, mingling with the silt-laden water of the lower Kechika. Here the drainage leaves the line of the Rocky Mountain Trench to join the Liard, just visible upper left, 0.7, 3.3, and the Rocky Mountains fall away to the upper Liard basin. (Roll 188 Film 27.)

7. *Aircraft at Lower Post*

The Fairchild 71C photographic aircraft at Lower Post, Liard river, during survey of 1939. The petrol drums on the bank were brought up in the flat-bottomed boat on the right.

8. *Sifton pass*

The vertical photograph was taken over Sifton pass (3270 feet) and shows the confluence of the sources of the Kechika river which flows north-west to the left. The point at 3.5, 1.6 is the height of land indicated on Plate 1 at 3.9, 1.8, and the same meadows can be seen draining to the Fox and Finlay. Waters separating here meet again where the Liard joins the Mackenzie at Fort Simpson, over 500 miles *via* the Liard, and over 1500 miles *via* the Finlay and Peace rivers. (Roll 185 Film 19.)

9. *Looking north-easterly across upper Liard basin*

The movement of Pleistocene ice has left a useful aid to navigation in this striking pattern of drumlins. The river, upper left 0.2, 2.7, is the Dease which can be traced to Lower Post 0.9, 2.9, on the Liard which winds eastward in the background. The cut banks of the Hyland river can be seen in the far background 1.5, 3.3, draining south from Yukon territory. (Roll 188 Film 56.)

10. *Moraine deposits in upper Liard basin*

The vertical photograph shows eskers and moraine deposits with kettle lakes in the upper Liard basin. The area shown is approximately $2\frac{1}{2} \times 2$ miles. (Roll 227 Film 17.)

DISCUSSION

Before the paper the PRESIDENT (the Rt. Hon. Sir GEORGE CLERK) said: Our lecturer, Captain Gerald Andrews, of the Royal Canadian Engineers, is a British Columbian who before the war served his Government in the Forestry Department and was more lately engaged in the surveys of the route for the British Columbia–Alaska highway as air survey engineer. His lecture this afternoon will give us an account of this important work with some discussion of the merits of other schemes.

Captain Andrews then delivered the lecture printed above, and a discussion followed.

The PRESIDENT: We have with us Mr. Ray Bourne, a friend of the lecturer and a forestry expert. I gather he would like to add a word or two.

Mr. RAY BOURNE: I have never been lucky enough to go to British Columbia, but we have all seen from the most excellent slides and air photographs what a wonderful country it is. Captain Andrews has several times during the course of his lecture emphasized how difficult it may be to carry out air photography because of unsuitable weather conditions. Many of you perhaps know that in Great Britain the days suitable for survey and ordnance photography from the air are limited in some years to eight or nine; in favourable years there are perhaps twenty days.

There has been a tendency in the past in many parts of the world to rely purely on private enterprise to carry out air photography. Canada has been an exception, for a large part has been done by the Canadian Air Force and by members of Government services. In the course of their ordinary routine flying they have taken air photographs which have been made available to the scientists and others interested. Australia had just before the outbreak of war followed Canada's example. I put forward the suggestion that if after the war the air forces which will then have to be maintained by the united nations could concentrate on increasing their routine photographic work and re-photograph at intervals the Empire and the world we should rapidly, as some of the photographs we have seen this afternoon have indicated, obtain an enormous increase in our knowledge of geography, geology, forestry, and every other subject connected with the development of the economic resources of the world.

The PRESIDENT: Captain Ignatieff, who before the war worked for many years in Canada would, I think, like to speak.

Captain IGNATIEFF (Russian Section, War Office): I did not see the British Columbia–Alaska route from the air, as Captain Andrews has seen it. I followed the route into Fort Ware on several occasions, and into the mountains behind, proceeding down the Peace river drainage connecting the British Columbian hinterland with the eastern side of the Rocky Mountains and the Peace river.

On those journeys what struck me most was that of all the countries I have seen this particular area had an influence on those who ventured to live in it under rather difficult conditions. It is a particularly virile, varied, and interesting part of the world. Unless one had actually been there, when looking at it on a map or judging it from the sort of latitude in which it is situated, one would imagine that it is not a very inviting country, that life is very hard, and that it is an area that can only be of interest to a few. I have seen that country both in winter and summer, and I found it extremely interesting and varied, with many natural resources and a variety of climate, all of which will help it to become an area of increasing interest with a great future.

The PRESIDENT: We have had a most instructive meeting. Captain Andrews was very modest as to his share in the work; actually he had an extremely difficult and arduous task. I am sure we shall all be only too glad to see the British Columbia–Alaska highway fulfilling its purpose. I express the thanks of the Society to Captain Andrews for his most instructive lecture.

THE COUNTRY ROUND THE KAVIRONDO GULF OF VICTORIA NYANZA

P. E. KENT

THE geographical changes which have given East Africa its varied character form one of the most fascinating of studies, and the vicissitudes of rivers, rifts, and glaciers have been traced in much detail by Wayland and his colleagues in Uganda, and by Leakey, Solomon, Nilsson, and others in Kenya. There is however a scarcity of data bearing upon Victoria Nyanza, the largest of the great lakes, particularly as regards its eastern side; the following is an account of observations made in the area in 1935 by the writer, while geologist to the East African Archaeological Expedition organized by Dr. L. S. B. Leakey.

Most time was spent in two areas: Kanam, near Homa on the south side of the gulf, and Rusinga Island at the mouth. Shorter periods were also spent at other places in the east and north. The examination of Kanam was carried out with Professor P. G. H. Boswell, that of the other areas independently. Maps of the two main areas were prepared by Mr. Stanhope White, expedition surveyor.

The Kavirondo gulf, the northernmost of the inlets which give the eastern side of Lake Victoria its irregular form, lies in the east–west Kavirondo rift valley which trends 80 miles east from the lake proper until it is concealed beneath the volcanic outpourings of Tinderet. In its eastern section the valley is flanked by two great scarps. The southernmost is not shown well on existing maps, but it is very prominent south of Koru and Muhoroni, rising to a height of 1500 feet or more above the valley floor (Plate 2), and then decreasing steadily westwards until it ceases to be recognizable near Kendu. In general it has a level, almost undissected skyline, in spite of the fact that much of the rock is relatively soft tuff and agglomerate, so that it is one of

1. Northern scarp of the Kavirondo rift

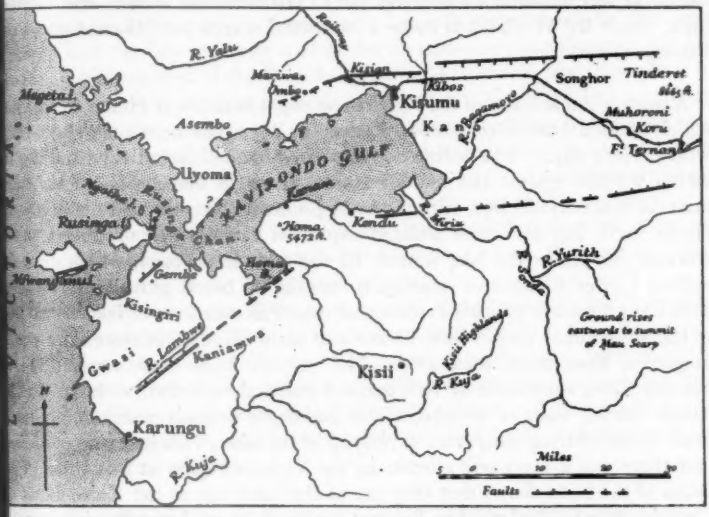
2. Southern scarp of the Kavirondo rift

3. Kavirondo gulf from northern scarp

4. Homa mountain from Kanam

e younger scarp of East Africa—not older than Pleistocene, and quite robably Middle Pleistocene. The incised U-bend on the Sonda river may e further evidence of recent movement, a point which study of high-level rraces might decide.

The northern, or Kisumu scarp ("Nandi" scarp of Gregory) shows very ifferent characters, and is of considerable age. Although it is made up of sistant pre-Cambrian rocks it has a jagged skyline (Plate 1), and Gregory corded that the Kibos river has cut through it to the level of the main lley. Its continuation westwards is a less imposing scarp set *en echelon* ightly off the same line which is clearly marked at least as far as the west de of the Mariwa-Ombo valley. This might be called the Kisiani Scarp om the river and township of that name. In 1935, during a general examina-



on of Miocene beds, the writer found that some relict Lower Miocene eposits located by Archdeacon W. E. Owen had been laid down in branching alleys cut into the pre-Cambrian rock of this scarp, which proves it to be at ast as old as Oligocene (Plate 3).

The floor of the rift is for the most part nearly level. In the east the Kano lain lying at the head of the gulf is low, flat, and locally swampy, with a thick over of cotton soil which makes many of the tracks impassable during the et season. Admiralty charts show that the floor of the gulf (shallow like ake Victoria) is remarkably level over broad areas, and the recurrence of helves of the same depth, for example at 17, 22, and 38 feet, in different arts indicates erosion during periods of lowered lake level. The flat floor of e rift is interrupted by rounded hills of Archaean rock and more striking olcanic mountains. The Archaean hills occur mainly in the north-eastern art, and sometimes show linear arrangements as though they were parts of enuded horsts (Plate 1).

The volcanic mountains are much larger. The extinct volcano Tinderet, rising to 9500 feet, blocks the eastern end of the Kavirondo rift, and on its dissected western edge tabular and conical hills of lava-capped Miocene rocks form a characteristic feature of the scenery from Muhoroni to Fort Ternan. On the south side of the gulf, Homa mountain (1750 feet above the lake) is a grand pile of lava and agglomerate, apparently mainly of Pleistocene age, rising steeply from a gently sloping area of lacustrine volcanic sediments (Plate 4); islands near the opposite shore also consist of volcanic rocks. West of Homa Bay the mountainous Gwasi volcanic mass of Miocene age extends over more than 100 square miles from Karungu northwards, and the islands at the mouth of the gulf, with the Uyoma peninsula on the northern side, are parts of its faulted and eroded northern margin. Here again a capping of basalt on soft sediments has given rise to characteristic conical and tabular hills, which led Wayland to make a successful search for Miocene rocks on Rusinga (1931).

Kanam.—An account of the Pleistocene deposits north of Homa mountain, which yielded human remains to Leakey in 1932, has been published elsewhere (Kent 1942). The sediments, deposited in an enlarged Kavirondo gulf which washed against the foot of Homa, show an alternation of volcanic material and normal clays, with coarse agglomerate beds derived mainly from Homa itself, but also from isolated explosion vents which produced small volcanic islands in the lake waters. In the earliest deposits, which contain extinct Lower Pleistocene mammals, streaks of beach gravel interbedded with the grey clays provide evidence of minor fluctuations of lake level, but in the subsequent period (late Lower and early Middle Pleistocene) a more important fluctuation took place. The greyish beds were succeeded by banded clays, suggestive of well-marked seasonal variation, with sandstone bands bearing casts of suncracks and carbonate crystals which must have been formed during temporary drying up of the lake. This is strong evidence that there was a semi-arid climate in the Victoria region at this time. The fauna of the beds shows that they are of the same age as the Kaiso Beds of Uganda, which Wayland has likewise assigned to an Inter-Pluvial Period. The succeeding deposits (Middle Pleistocene of Kanjera) display none of the characteristics of desiccation, and the wet climate had presumably returned when they were deposited.

There is thus close similarity between the histories of western Kenya and Uganda, and Solomon's questioning of the reality of the Pluvial Periods of Uganda because of the absence of parallel sequences elsewhere (1939) loses much of its force. It is relevant to point out that northern Tanganyika shows a parallel sequence. The Oldoway Gorge shows 300-foot sections in lacustrine volcanic deposits (thinly bedded, with *Hippopotamus* and *Protopterus*, hence certainly water laid, although the depression does not now contain so much as a salt lake) which are dated as Middle Pleistocene by the rich mammalian fauna and abundant human artifacts. This series rests on a lava flow, but slightly earlier fossiliferous beds were found in 1935 on the plateau north-west of Lake Eyasi. These proved to be subaerial tuffs, and their deposition almost to the edge of the pre-existing Eyasi rift indicates a climate as dry as, or dryer

than, the present one, for they would otherwise have been eroded before consolidation (Kent 1941). Evidence of a dry period at the beginning of the Middle Pleistocene, with a subsequent wet period, agrees perfectly with Uganda and Kavirondo, and fluctuations during the wet period also show close agreement (Wayland 1934).

After deposition, the lacustrine beds were gently folded and faulted, and a period of planation which followed reduced the area to an even surface, which now slopes from approximately 300 feet at the foot of Homa nearly to lake level. That this was originally a nearly level surface which has been tilted is indicated by the fact that the lacustrine beds themselves show a northerly dip of similar amount. The tilting is a complicating factor in the effort to determine the elevation of the original lake surface, but it is not unlikely that the "hinge" was in the south near the Archaean outcrop, and that the lakeward part in the less stable volcanic area has relatively subsided. The high-level lake of the Lower Pleistocene would therefore be approximately 300 feet above lake level, that of the Middle Pleistocene probably less than 200 feet; figures which agree with the evidence given below. Clearly marked beach flats at 60–70 feet and 20 feet, and a less definite flat at 40 feet above lake level have been cut since the initial planation and tilting came to an end. After formation of the main flats a period of erosion produced moderately broad valleys, graded with relation to a base level not much different from that of the modern lake surface. In these valleys were deposited fluviatile clays and gravels very like the Gamblian deposits of the main Upper Pleistocene pluvial period in the Eastern rift valley (Solomon 1931).

Neolithic shell mounds close to the modern shore point to relative stability in most recent times, and the main geographical change now in progress is the rapid cutting and widening of steep-sided gullies and ravines in the Pleistocene deposits. This process is tending to produce picturesque long winding ravines on the lines of the sediment-choked valleys formed during the Upper Pleistocene, and broader areas of "bad land" topography in the older lacustrine sediments.

Region round the mouth of the gulf.—The islands and peninsulas at the mouth of the gulf vary considerably in character, largely as a result of differences in the volcanic rocks of which they are formed (Plate 5). Kisingiri to the south was the old volcanic centre, and faulting and extensive erosion have greatly changed the original landscape, so that massive agglomerates and lavas now make up mountains with precipitous faces. Mfwanganu, the westernmost large island, lay a short distance from the main centre, and thick agglomerates and lavas form a plateau flanked by steep cliffs, probably the result of faulting. On Rusinga the volcanic deposits are thinner, and contain in the east and west soft lacustrine beds in the lower part, hence the conical and tabular hills resulting from the more rapid destruction of less resistant material. The central mountain Lunene, rising to 1064 feet above the lake, contrasts with the surrounding hills in being rugged and bush covered, showing that the bedded lacustrine deposits overlap what was originally an island of older agglomerate in the Miocene lake. On Uyoma the agglomerates are again thin, and the peninsula is a lava plateau 100–300 feet above the lake.

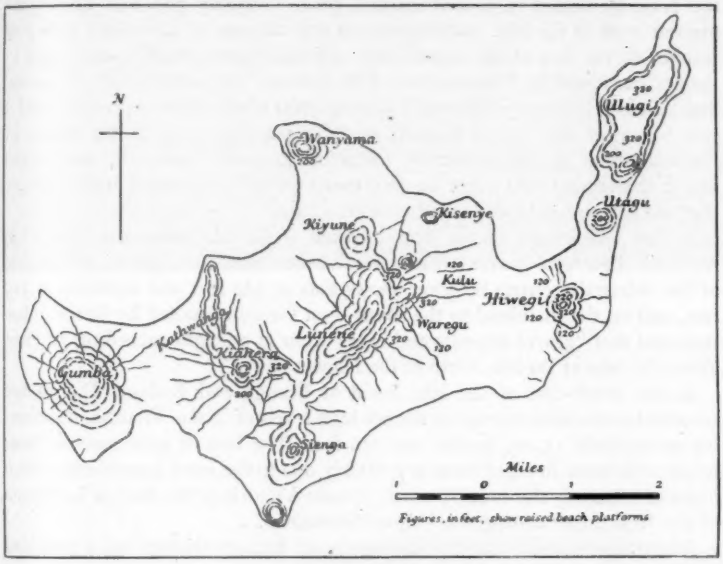
The coastlines provide an interesting study. Rusinga has a very irregular outline, with rocky ridges running out to form promontories; the characteristics of a drowned coast (Plate 5). Kisingiri (Plate 7), and much of the northern coast of Lake Victoria have the same characteristics. Mfwanganu contrasts with Rusinga in having a simple outline. It is essentially a section of plateau which slopes east and north from a highest point 1770 feet above lake level in the south-east, bounded on the east by steeply sloping ground and on the south by a magnificent cliff above the narrow coastal plain. The plateau surface is crossed by shallow valleys which begin as wind gaps in the cliffed southern margin (Plate 8), and therefore must have been initiated on a surface which had an appreciably greater southerly extension than the present plateau. The beds are however thickening in this direction, and the original eruptive centre probably lay only a few miles to the south. Normal erosion would neither have completely destroyed the highest ground first, nor have produced the southern cliff of Mfwanganu, which shows few indications of active erosion, water courses are small and limited to the low ground, so that one may assume that the isolated block-like character and simple outline of Mfwanganu are the product of faulting, and that the southern cliff is the relatively fresh face of a fault scarp.

Wayland (1931, p. 24) has shown that south of the gulf the straight north-east–south-west edge of the Kaniamwa plateau is probably due to a fault; moreover the north-western face of Gembe mountain is almost certainly the product of a fault of the same strike. Sections of coast as well as inland features follow this direction, and the contrast with the irregularity of shorelines elsewhere suggests that they are coincident with faults. The south-eastern shore of Homa Bay for example is formed by a line of low bluffs, and was probably determined by a continuation of the Kaniamwa fault, with which it is aligned. The straightness of the east coasts of Rusinga and Uyoma also suggests faulting. Both faulting and drowning thus seem to have had a part in determining the present coastline of the western part of the Kavirondo gulf.

On Rusinga the most significant of the physical features are high beach platforms, which occur at three clearly marked levels: 320, 200, and 120 feet above the present lake. The 320-foot platform is developed both as flat tops on the smaller hills, particularly in the north-east, and as a terrace on the lower slopes of the central mountain, Lunene. The flat tops of the hills are shown to be true erosional platforms by relics of higher beds remaining as hillocks on the flats, and by their independence of such structural features as faults. The 320-foot platform is developed in the same way on the neighbouring island, Ngothe. The terrace on the east side of Lunene is proved to be a beach flat by the drainage; the streams, incised in gullies of varying depths, are numerous, straight, and parallel, with courses completely independent of the structure or variations in hardness of the underlying rock, clearly a case of superimposition.

The 200-foot platform is more restricted in development, but one hill, Utagu, is truncated at this level, and of the terraces in other places at least one, on Wanyama, was seen to be independent of the geological structure. At one point south of Kiahera sands and gravels are associated with this terrace.

The 120-foot beach platform is particularly well marked east and west of Hiwegi hill (Plate 6), where it forms a broad terrace sloping gently towards the lake. The hard bands in the Miocene beds and the faults which cut them produce no features on this flat, and the streams are parallel and without branches, again evidently incised on a surface originally level. The platform was also observed north-east and east of Kiangata hill in the Kulu district, where it showed similar characteristics. A little farther south at the same level early Palaeolithic hand axes were abundant, associated with a gravelly soil. This provides an indication of the age of the flat, for early man probably lived and worked close to the lake edge, and the 120-foot beach may have been formed during the Middle Pleistocene. Suggestions of a flat at about 70 feet were also



Rusinga Island

noted east of Hiwegi, and still lower beach platforms are probably present, but low-angled slopes made them difficult to distinguish elsewhere.

The good preservation of the higher flats is due to their being cut mainly in hard rock, agglomerate and lava, and their formation doubtless took a long time. On the other hand, the 120-foot beach is cut in the softer rock at lower levels, but its considerable breadth shows that it must also have taken long to form. The considerable period needed for the development of the beaches as well as the elevations of the Lower and Middle Pleistocene sediments at Kanam indicate that the 320 and 200-foot platforms are older than that at 120 feet, and are almost certainly Lower Pleistocene.

The extent of the raised beaches.—The raised beaches have considerable local interest, but become of much greater importance when related to similar

occurrences in the surrounding region. Terraces were clearly marked at heights approximating to 300, 200, and 100 feet above lake level on a bluff north-west of Maboko island on the northern shore of the gulf, and these, with the known elevation of the Kanam Pleistocene Beds, and the evidence from published maps of 300 and 120-foot flats at other places around the gulf, strongly suggest that the high-level beach platforms of Rusinga are characteristic of a region at least as extensive as the Kavirondo gulf area. In view of the possibilities of local earth movement and major geographical changes however this does not necessarily imply that Victoria as a whole had a similar history, and other evidence has to be taken into account.

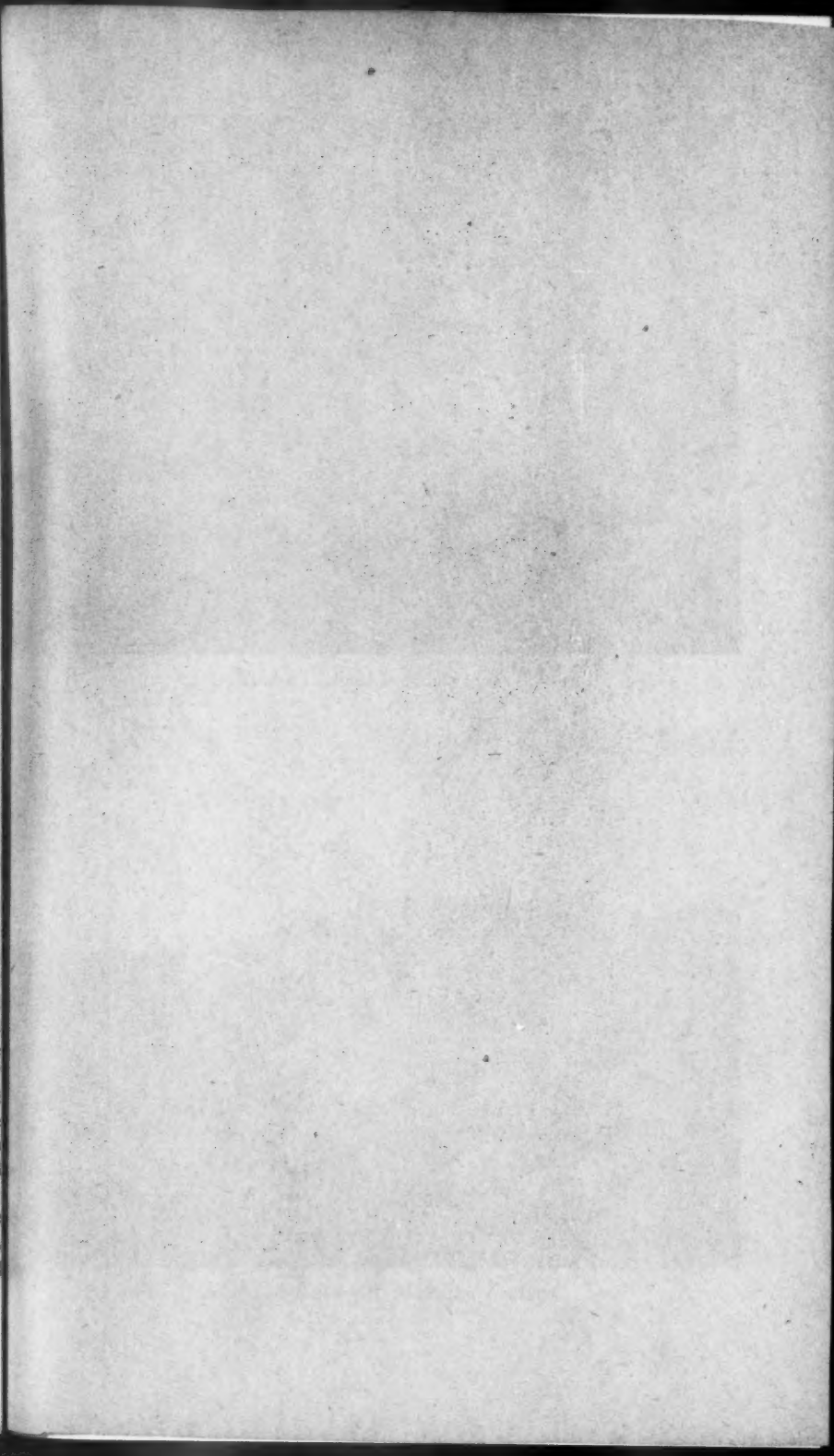
Oswald provided data for the Karungu area in 1914. He pointed out that the Kuja is incised in a well-marked plain "roughly 300 feet above the present level of the lake, which must (at this altitude of 4000 feet) have just reached to the foot of the basalt cliffs, and must have chiefly contributed to the destruction of the Miocene beds at their base." A platform cut in Miocene beds is clearly shown in Oswald's photographs of the Nira exposures, and a spot height of 296 A.L. is marked on accompanying maps. A flat shown in illustrations of the neighbouring Kachuku exposures bears the spot height of 240 at the landward edge. In each case Oswald's geological maps indicate that the flats are independent of rock structure.

In the Sese islands on the opposite side of the lake Simmons (1926) has recorded high-level gravel terraces, but no elevations were given. Inspection of the Admiralty charts however shows flats at 220 feet and summits at 315 feet, and on the mainland to the south-west Garstin (quoted by Oswald) has recorded that "gravel deposits and caves occur at a height exceeding 300 feet above the lake at Buddu, north of the Kagera river."

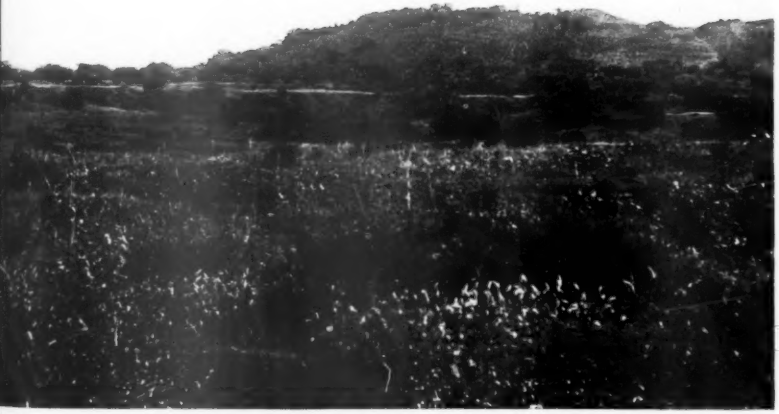
In the north-east of the lake basin at Busoga and Budama Davies has recorded abundant evidence of former high levels of Lake Victoria, mentioning particularly 15, 25, 50–80, and 150 feet. The lack of agreement of these levels with those in other areas is probably due to the earth movements which lowered relatively the country north of Lake Victoria at the time of formation of the Jinja outlet during the Upper Pleistocene.

Additional evidence that the Rusinga beach flats are widespread is provided by an account of Buvuma Island by Wayland (1925). The highest flats are rather more than 300 feet above lake level, and were regarded doubtfully as beaches, but possibly parts of a peneplain graded to an ancient Lake Victoria: in either case a water level some 300 feet above the present surface would seem to be necessary. Lower than this were ironstone flats with pebbles and boulders at 200, about 125, and 50 feet. Human artifacts embedded in the ironstone at 50 feet and loose at 125 feet were of "early Mousterian facies." Still more evidence is provided by the terraces of the Kagera (Wayland 1935). This shows four terraces at 270, 220, 110, and 30 feet, which were presumably related to different surface levels of Lake Victoria; the highest is dated as early Pleistocene, the second as early Middle Pleistocene, the third as late Middle Pleistocene, and the low terrace as Upper Pleistocene.

The coincidence of levels in the above records, which comprise the whole of those known to the writer, is unmistakable. Erosion platforms at 300, 200, and 100 feet above the present lake are very widely distributed, and the dating



5. Rusinga Island from the west



6. Gullied 120-foot beach platform, Rusinga

7. Kisingiri coast from Mfwanganu

different places shows agreement. Thus an assumed Lower Pleistocene ate for the 200 and 320 foot levels at Rusinga compares with Lower to early Middle Pleistocene for terraces at these heights on the Kagera, whilst a Chelleo–Acheulean age for the 120-foot beach at Rusinga compares with a ate Middle Pleistocene date for this level on the Kagera and contrasts with he "Gamblian" date of the 30-foot terrace at the latter place and an early Mousterian age for the 50-foot terrace at Buvuma. Wayland, in a résumé of he subject, mentioned only flats at 170, 120, 70, 30, 20, and 15 feet, without iving details of distribution (1934), but his other work cited above and an arlier statement: "high level gravels occur . . . up to a maximum which is ery considerably above Lake Victoria . . . this maximum approaches 300 eet" (1923, p. 5), suggest, in the light of present evidence, that his final onclusions were somewhat over cautious.[1]

The first and obvious conclusion is that at least the northern half of the Victoria basin was filled to approximately 300 feet above its present surface uring the Lower Pleistocene, and that the water-level fell progressively with auses at about 200 and 120 feet, the latter in the later Middle Pleistocene. The data outlined above have further significance. In the paper already cited 1939), Solomon has postulated the tilting of the whole Victoria region, first o the south-west and then to the north-east. The coincidence of the beach nd terrace levels on opposite sides of the lake extending throughout the Pleistocene is strong evidence against this conception; if the correlation of the eaches is at all sound, the tilting hypothesis has to be discarded. Furthermore, an argument in Solomon's case was based on the submerged character f the north-eastern coastline of Lake Victoria (although in any case it was not lear why the south-eastern and north-western coasts should show the same eature), and any older beach platforms thereabouts should be submerged eneath the lake; they are, on the contrary, seen to occur up to high levels on usinga Island and in the surrounding area. On general and on detailed rounds therefore the evidence is directly against the hypothesis of river eversals by regional tilting.

The data collected in Kavirondo both support and extend the findings of Wayland and his colleagues in Uganda. The evidence of Pleistocene climate grees closely with the sequence in the Albert rift valley, and that of former ake levels accords with information from the islands and shores of the Uganda ide.

In the early Tertiary, dislocation of the African peneplain by faulting led to he production of the northern scarp of the Kavirondo rift, and a subsequent ovement produced a partially closed depression to the south of this, in hich lacustrine sediments of Lower Miocene age were deposited. A phase

[1] The southerly extension of the enlarged lake has however been overestimated. rantham, Temporley, and MacConnell have recently reported the complete absence f lake deposits or high-level terraces at the southern end of the lake, so that it seems kely that the fall in water-level has here been accompanied by a down warping of the nd. The occurrence of swamps and lakelets in river valleys along an east–west line assing through Singida provides independent evidence of local depression in the gion of the divide between the Lake Victoria and Lake Eyasi basins. It therefore ems unlikely that the two basins were united during Pleistocene times.

of violent vulcanism ensued, and the subsequent history of the Miocene Beds was complicated, but it is probable that the Miocene lake soon ceased to exist and erosion of the lacustrine and volcanic deposits began. In Uganda, the Pliocene denudation has given rise to arid land forms, but evidence of this has not been recognized in Kavirondo; considerable erosion however took place.

Lake Victoria first came into existence in early Pleistocene times, the date has been determined in Uganda by Wayland and Coombe, when the rise of the longitudinal bulge associated with the western rift interrupted the normal westward drainage of the region. Discovery of an eastern species of fish in the Lower Pleistocene of Kanam leads one to suspect a contemporaneous rise of the eastern rift, which apparently reversed the head waters of a river draining eastwards from the Kisii Highlands (Kent 1942). Between the two rift zones the ponded waters of the lake rose to a high level. There is widespread evidence suggesting that in the northern part the maximum was approximately 300 feet above the present surface, with a fall to 200 feet during the Lower Pleistocene. In this high-level lake 80 feet or more of alternating volcanic and normal lacustrine sediments were deposited at Kanam, and in them were entombed the remains of a rich fauna of archaic mammals. Overlying deposits which span the Lower-Middle Pleistocene boundary show evidence of great desiccation (the Kaiso Inter-Pluvial) and partial extermination of the fauna possibly resulted at this time from the drying up of Lake Victoria (Worthington 1933). Wet conditions returned, and left as evidence the Kanjera deposits and the 120-foot beach platforms, each associated with Chelleo-Achulean artifacts.

Kavirondo does not throw much light on Upper Pleistocene events. The open valleys filled with fluviatile beds presumably date from the main wet period, and there are raised beach platforms at 60–70, 40–50, and 20 feet above the present lake. The erosion of these platforms may well have alternated with sub-normal lake levels, for which the existing submerged shelves of the Kavirondo gulf are evidence.

NOTES ON THE ILLUSTRATIONS

1. *Northern scarp of the Kavirondo rift*

The old dissected Kisumu scarp photographed from the eastern end near Songhor. A horst-like chain of hills of pre-Cambrian rocks is seen in the middle distance.

2. *Southern scarp of the Kavirondo rift*

View south and south-east from near Koru station, showing the even, undissected skyline, evidence of relatively recent date.

3. *Kavirondo gulf from the northern scarp*

Looking southwards down a valley cut into the northern scarp in pre-Miocene times. Relics of the original Miocene beds deposited in the valley can be seen forming a light-coloured patch in the valley bottom, and plateau lava later than the Miocene beds is seen on the hilltop on the left. Across the gulf Homa mountain can be seen.

4. *Homa Mountain from Kanam*

The denuded volcano is seen across the gullied 70-foot beach flat, cut in lacustrine Lower Pleistocene beds.

5. *Rusinga Island from the west*

Photographed from the highest part of Mfwanganu, showing the deeply embayed drowned coast and the characteristic conical hills of Miocene deposits. The low Uyoma peninsula is seen behind Rusinga on the left, the mountains of Kisingiri are seen on the right, and Homa Mountain is visible in the distance across the mouth of Homa Bay.

6. *Gullied 120-foot beach platform, Rusinga*

The level platform cut in Miocene beds on the western side of Hiwegi hill when the lake stood 120 feet higher than at present is clearly seen behind the gullied area, and the older 320-foot platform occupies part of the hilltop above.

7. *Kisingiri coast from Mfwanganu*

A view southwards, showing the drowned character of the coastline and the rugged scenery of the old volcanic centre.

8. *Plateau of Mfwanganu*

The photograph was taken looking westwards from near the highest point, showing valleys crossing the plateau in the middle distance, and the top of the steep scarp forming the southern edge of the high ground on the left. Lake Victoria stretches away to the horizon beyond.

REFERENCES

Davies, K. A. (Busoga and Budama), *Ann. Rep. geol. Dep. Uganda*, 1932, p. 39.

Kent, P. E. "The recent history and Pleistocene deposits of the plateau north of Lake Eyasi, Tanganyika." *Geol. Mag. Lond.* 78 (1941) 173–84. "The Pleistocene beds of Kanam and Kanjera, Kavirondo, Kenya." *Geol. Mag. Lond.* 79 (1942) 117–32.

Oswald, F. "The Miocene beds of the Victoria Nyanza." *Quart. J. geol. Soc. Lond.* 70 (1914) 128–98.

Simmons, W. C. "Summary . . . of a geological survey of the Sese Islands." *Ann. Rep. geol. Dep. Uganda*, 1926, pp. 19–21.

Solomon, J. D., in Leakey, L.S.B. 'The Stone Age cultures of Kenya Colony.' Cambridge, 1931. In O'Brien, T. P. 'The prehistory of Uganda Protectorate.' Ch. II, pp. 15–50. Cambridge, 1939.

Wayland, E. J. "Some primitive stone tools from Uganda," *Pt. I, Occas. paper No. 1, geol. Surv. of Uganda*, 1923. "Ancient lake levels" (Buvuma). *Ann. Rep. geol. Dep. Uganda*, 1925, pp. 9–11. "Report on a geological reconnaissance of South Kavirondo." Nairobi, 1931. "The Rift Valley and Uganda waterways." *Summ. Progr. geol. Surv. Uganda*, 1919–29, pp. 40–44. "Pleistocene history and the Lake Victoria region." *Bull. No. 1, geol. Surv. Uganda*, 1934, pp. 72–77. "The M-Horizon. A result of a climatic oscillation in the Second Pluvial Period." *Bull. No. 2, geol. Surv. Uganda*, 1935, pp. 69–76.

Worthington, S. and E. B. 'The inland waterways of Africa.' London, 1933.

A NOTE ON THE TUZ ÇÖLÜ

PROFESSOR F. S. BODENHEIMER

AT the end of a three-year stay at Ankara as Government Entomologist to the Ministry of Agriculture, I had an opportunity of visiting Koçhisar, a town on the eastern shore of the Salt Lake (Tuz Gölü), about 170 km. south of Ankara. Most phytogeographical and many general maps show a wide stretch of land around the Tuz Gölü as Tuz Çölü, the Salt Desert. The elucidation of the general and faunal character of this Salt Desert seemed very desirable, as I was much interested in the zoogeographical zones of Central Anatolia. I was accompanied by Mr. Tevfik Karabag, assistant in the Zoological Institute of the Agricultural High School at Ankara. We left Ankara early on 28 May 1941, arrived the same evening at Koçhisar, and returned the next evening to

Ankara. The short duration of the trip, caused by circumstances beyond our control, explains the cursory character of the exploration. There is however no doubt that the conclusions gained are soundly based.

Beyond Bala, the only town on our way, the steppe was in full flower. Large compact patches of flowers, blue (*Delphinium*, *Anchusa*), red (*Cirsium* and other thistles), and yellow (*Genista*, *Achillea*) were mixed or alternated with grasses (*Stipa*, *Festuca*) and elsewhere with *Artemisia fragrans*. Compact grass steppes prevailed farther south. Among animals the presence of many colonies of *Citellus* was most striking. Their holes are common everywhere, they often crossed our road or were seen frisking on the sides of the road. Some yellowish brown steppe foxes and steppe hares were also seen. Among the birds were eagles, vultures, bustards, a few *Coracias garrula* among trees near watering places of sheep, many Bee-eaters, very many larks and starlings. The chukar (*Alectoris caucasica*) and the houbara (*Chlamydotis macqueenii*) are said to be common game in these parts.

When we approached the Tuz Gölü, we inquired in every village where the "çöl" (desert) would begin. We unvariably received the reply: "Oh, some

kilometres farther south." The distances between the villages were fairly large and the character of the landscape rather dry and steppe-like. We were well into the area commonly called the Salt Desert, but not a single character differentiated this landscape from the steppes surrounding Ankara. And when we finally arrived in the neighbourhood of the north-eastern shore of the Tuz Gölü, the steppe grew even more confined and on the eastern shore of the lake there were fields of wheat and barley to within 1 km. of the lake in many places. The soil of these fields is fairly dark brown, which does not indicate extreme aridity; and the fallow alternates with the crop, which is the normal condition of good agricultural soil in Central Anatolia.

The Tuz Gölü is a rather shallow lake, which dries out, with the exception of a few small, deep patches, every summer. The salt crusts covering the dried bottom area of the lake are collected by the Government monopoly. At the time of our visit the lake had begun to dry out and a littoral margin of between 1 and 150 m. was dry. Behind this zone there were a few metres without much vegetation, followed farther landwards by a few metres of dense growth of extremely halophytic vegetation (mainly *Salsolaceae*). Immediately beyond these there was the normal steppe of *Artemisia* or of grasses. On the salt crust of the dry lake floor a water line was visible where many dead insects were deposited (mainly ants, a few beetles and moths).

The old town of Koçhisar is a typical steppe oasis. Its approaches recall Damascus. There are irrigated gardens of apricot, plum, and a few apple trees, vineyards, and intensively cultivated vegetable gardens, with elms, willows, and poplars for ornament.

The fauna collected along the shores of the lake was rather poor and typically steppe-like, but the rather common presence of *Malpolon* indicates that no extreme steppe conditions prevail.

The Tuz Çölü or Salt Desert of Central Anatolia is therefore a fable. Perhaps the dry aspect of the landscape in late summer may have led European visitors to call the surroundings of the Salt Lake a desert. As the botanist Krause states that the eastern shore of the lake, which we visited, is the more arid one, our conclusion is valid for the entire area of the so-called Tuz Çölü.

When we returned, we asked some of the villagers, who had told us before, that the Tuz Çölü would begin some kilometres farther south, why they had told us this. They replied: "Amma orada çölü tabiye var" (But there is a desert nature). Finally they agreed that their own territory is also çöl, that çöl is every treeless tract of land and that the Tuz Çölü, *i.e.* the çöl around the Tuz Gölü starts farther south. It thus becomes clear, and this has been confirmed by many Turkish friends, that the spoken Turkish language does not differentiate between steppe and desert. Çöl refers to both. The recently accepted term for steppe, "bozkırlar," I have never heard from any peasant.

It is very astonishing that a people of nomad origin such as the Turks, in whose economy husbandry still plays a predominant role, do not differentiate between the two habitats. It is also, but less, astonishing that neither the Romans nor the Greeks had different words for desert and steppe. Eremos in Greek and deserta in Latin embrace both. It is a peculiar coincidence that the stretch of land between Koçhisar and Konya was called "Axylon,"

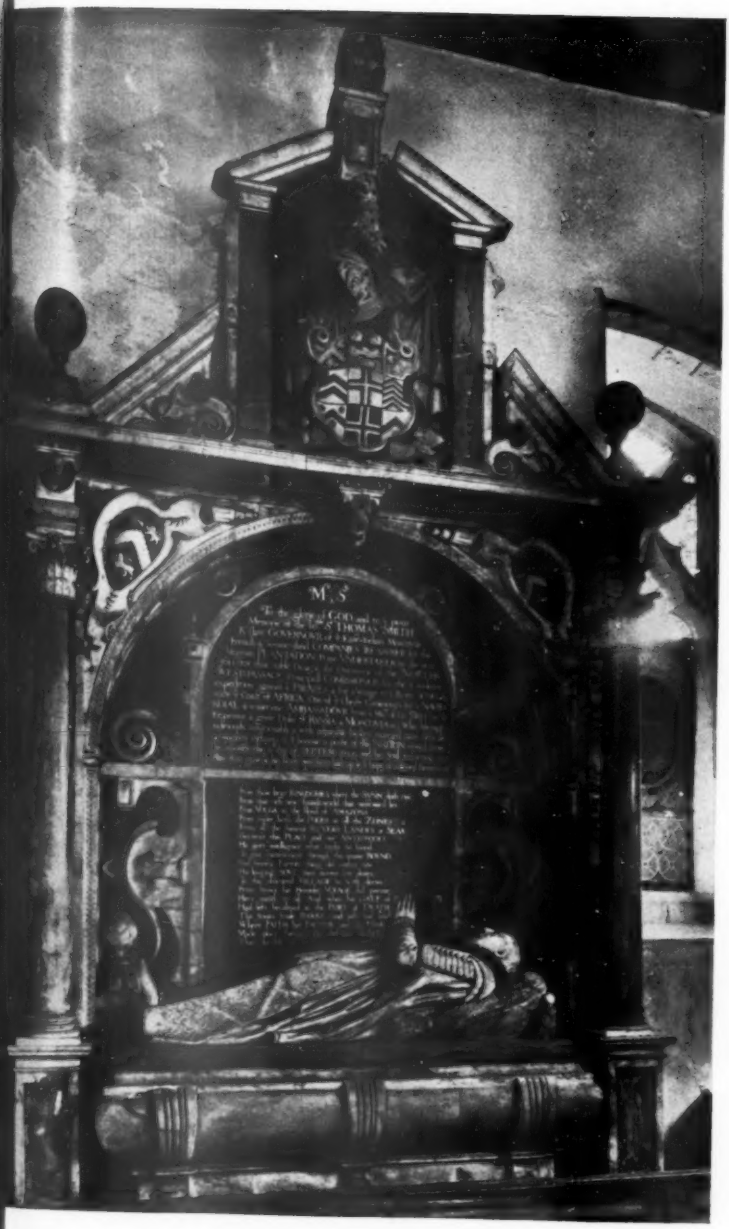
the treeless, by the old geographers, because these are just the words in which the peasants explained to the writer the character of the word "çöl." The Tuz Çölü is by no means the only steppe, which has been mistaken for a desert: for instance, the so-called deserts of Arizona with 250–350 mm. annual rainfall and a shrub vegetation, which permits the maintenance of a considerable population of cattle throughout the entire year, are really steppes.

THE MONUMENT OF SIR THOMAS SMITH AT SUTTON-AT-HONE

THE monument to Sir Thomas Smith in the church of Sutton-at-Hone, in Kent, is of especial interest to geographers, for the man it commemorates did much for exploration and the development of commerce. The church has already received some damage by enemy action; and the question of protection for the monument was brought to the notice of our Society by Mrs. Esdaile, the member of the Master of the Rolls' Advisory Committee charged with the special care of monuments. The Council, R.G.S., have approved a contribution from the Society towards the cost of building a brick protecting wall; and it is appropriate to give here Mrs. Esdaile's account of this monument, illustrated with a new photograph taken for the National Buildings Record.

Sir Thomas Smith was a grandson of Sir Andrew Judd, who founded Tonbridge School; a member of Queen's College, Cambridge; first Chairman of the East India Company; an influential man on the Board of the Russia, French, Bermudas (Somers Islands), Guinea, Guiana, and Virginian Companies; member of the Board of Admiralty, and of the Board for the Suppression of Piracy. He financed Jackson's and Baffin's expedition to find the North West Passage, and Smith's Sound is named after him. His embassy to Russia resulted in the opening of the port which became Archangel. These and other services to his country are named in the finely lettered epitaph and accompanying verses which may be read on the enlarged photograph.

The tomb is a stately canopied structure with a narrow cornice which, in defiance of the Orders, is placed direct on Corinthian columns; on this cornice is a tall pedimented escutcheon with admirable mantling, surmounted by a tiny scrolled tablet bearing a skull, and flanked by a second broken pediment and by globes. Under the cornice is a semi-circular arch, the spandrels filled by baroque shields, and under the arch the prose inscription. In a separate rectangular tablet below come the verses, and below them, with a globe at head and feet, the gowned effigy of Sir Thomas on a banded sarcophagus resting on three plain feet and framed by the panelled bases of the columns. Round the verse tablet are "antiques" (the contemporary term for low relief decoration), such as cover the panels behind the columns. The



M. S.

To the glorie of GOD and to ỹ pious
Memorie of the ho^ble S^r THOMAS SMITH
K^t late GOVERNOVR of ỹ East-Indian Moscovia
French & Sommer-Iland COMPANIES TREASVRER for the
Virginian PLANTATION Prime VNDERTAKER (in the war
1600) for that noble Designe the Discovery of the NORTH-
WEST PASSAGE Principall COMISSIONER for the London=
expedition against ỹ PIRATES & for ỹ Weying of ỹ River SENEGA
upon ỹ Coast of AFRICA One of ỹ Chefe Comaunders for ỹ NAVY-
ROIAL & sometyme AMBASSADOVR from ỹ M^tie of Gr BRITT to ỹ
Emperovr a great Duke of RVSSIA a MOSCOVIA &c) Who having
subtilly circumvently & with admirable facility managed many difficult
& weighty Affaires to ỹ honour & profit of the NATION rested from
his labours the 6^th day of SEPTEM 1626 and his soul returning to
Him that gave it, his body was here laid upon ỹ hope of blessed Resurrection

From those large KINGDOMES where the SVNN doth rise
From that rich new found world that west-ward lies
From VOLGA to the Head of AMAZONS
From vnder both the POLES to all the ZONES
From all the famous RIVERS LANDES & SEAS
Between the PEACE and our ANTIPODES
He gave intelligence what might be found
To gain commerce through the massie ROVND
[illegible]
[illegible]
the hoping SOVL [illegible]
In that deserted VILLAGE [illegible]
From hence his Heavnlie VOYAGE did perform
Here rested vp all And when his GATE [illegible]
Had left becomm'd in the PORT [illegible]
The Soule took BANKE [illegible]
Where FAITH his PASTOR and [illegible]

right-hand globe on the cornice bears a map of the world illustrating Sir Thomas's enterprises from the Amazon to the Volga, from Baffin's Bay to Senegal. The antiques behind the columns are very elaborate and exquisitely carved. Sextants and quadrants, globes, compasses, galleys in full sail (men-of-war are frequent in the eighteenth century, but merchantmen are always very rare), corded bales, barrels, all wrought into a graceful pattern which only discloses itself on close examination.

As to the sculptor, we may at once discard the Southwark schools of Gerard and Nicholas Johnson and of the Cures: they use the architrave, and do not simply disregard it. Nor is the heraldry or the delicate display of antiques the least like their work, in which there are no oval baroque shields. It is certainly not Colt's work: a glance at Queen Elizabeth's tomb will show that. First-rate heraldry and mantling: we have them both in alabaster, and the Evesham family tree in the British Museum and the College of Arms, and they are from first to last as characteristic of Epiphanius Evesham as is skill in relief and an odd fantasy of form, often quite unarchitectural. The background of the signed Hawkins monument at Boughton-under-Blean is quite in keeping with the unsupported ornament between the broken pediment at Sutton-at-Hone; even the surmounting skull is of Evesham type, as it appears on the signed tablet at Hythe. The delicate mouldings and tiny scrolls are also like his documented work, and his use of unorthodox antiques is abundantly attested. Though the matter cannot be considered settled, the indications are that the tomb may be the work of Evesham, which, together with its great historical interest, makes its protection of importance to-day.

REVIEWS

EUROPE

DRIFTWOOD AND TANGLE. By MARGARET LEIGH. *London: Macmillan*, 1941. $7\frac{1}{2} \times 5$ *inches;* viii + 224 *pages; frontispiece.* 7*s* 6*d*

This book is a series of essays dealing with Highland and Island life and scenery, with a few random reflections on Ireland, some personal experiences, and reminiscences added. At first these seem unconnected, but one finds that the series takes one through a number of aspects of the Western Highlands. Fine descriptive passages stir the memory: the waving tassels of cotton grass on the moor, a summer day in the Western Isles, the stillness of the glens, waves breaking on the strands of Barra. Through it all there runs the underlying sadness of those parts. The problem of the decay of the communities is discussed in a reasonable and sympathetic manner. One wonders with the writer if the war may prove a blessing in disguise to the islands, whether with the curtailing of sea and road transport the new generation of crofters will regain some of the old self-sufficiency of their forbears. The book does not pretend to have any particular geographical significance. Places are mentioned incidentally, but the names only serve to fill in the background. The book can be read at a sitting or enjoyed a little at a time in the pleasant ambling way in which it was written. In these days when Highland holidays are forbidden it takes one back to many half-forgotten scenes.

J. M. M. H.

IRISH HERITAGE. By E. ESTYN EVANS. *Dundalk: W. Tempest*, 1942. $9 \times 5\frac{1}{2}$ *inches;* xvi + 190 *pages; illustrations and diagrams.* 8*s* 6*d*

Mr. Estyn Evans, head of the Department of Geography in Queen's University, Belfast, provides in small compass a very readable introduction to the history of Irish country life in relation to the physical setting. This is the summary of the results of much field work in Ulster, though he emphasizes the applicability of his conclusions to the whole island. The book is attractively produced, and illustrated with numerous careful pencil drawings. His chapters cover the physical geography, villages, farms, and fields, the routine of the farming year, festivals, and fairs, with special attention to traditional survivals. The effect of the break up of the old rundale agriculture upon the distribution of settlement is clearly shown, and the widespread influence of seasonal pastoral migration in historical times. The latter he considers to have been largely overlooked by students of history and literature. Much of the interest of his book lies in his demonstration of the extent to which customs have persisted although the social system which gave them their original significance has disappeared. He admits the difficulty, in a country subjected to considerable external influences, of assigning definite origins to all the characteristics observed, but his book indicates the manner in which future research should be conducted. Perhaps because he refrains from political and economic aspects, his picture may appear somewhat idealized: he does at least remove, by explaining the actual circumstances, some misconceptions of Irish life and character. Ireland, for better or worse, is now a land of peasant proprietors: it is by studies such as this that future progress can be assisted.

G. R. C.

THE ROADS OF MEDIAEVAL LAUDERDALE. By R. P. HARDIE. *Edinburgh: Oliver and Boyd*, 1942. $9\frac{1}{2} \times 6$ *inches;* xvi + 106 *pages; map.* 7*s* 6*d*

It is no contradiction to say that, for the average reader without special intimacy with the district, this excellent book is somewhat dull. The greater part consists

of extracts from every available charter or other mediaeval document that could throw light on the exact position of the roads and trackways, or in other words of the foundations on which the conclusions are based. These are dull for most people, but there can be no doubt that in this case they are sound and truly laid. The book may well serve as a model for those engaged on similar studies, though it may not always be necessary to expose the foundations so fully to view.

Of special interest is the fact that in one case a stream has been diverted in mediaeval times. Towards the end of the twelfth century the monks of Melrose acquired additional pasturage and built a large farm with accommodation for one hundred and twenty cows at Whitelee. They needed an increase in the water supply, which was effected by diverting the Fasse burn to run into the Halkburn, which enters the river Gala some 2 miles below the point at which the Fasse burn originally ran into it. But the old course of the latter was also a parish boundary which was now diverted to run along the intervening ridge: "thus Stow would gain a strip of land and Melrose an increased supply of water in the burn at Whitelee," to which we may add that a cunning trap would be set for the unwary topographical historian. Mr. Hardie's account would be greatly improved by a reproduction of part of the 6-inch map showing the diversion and the contour of the ground which made it possible. For this and other details the 1-inch map at the beginning of the book is hardly adequate. The author frequently refers to the 6-inch maps and in one passage a boundary line is said, somewhat elliptically, to be "marked on the 6-inch O.S. map by means of fourteen large stones." A number of interesting place-names are incidentally traced through their mediaeval forms to their origins. In short, Mr. Hardie has given us an eminently sound piece of work. C. N. B.

ASIA

MODERN IRAN. By L. P. ELWELL-SUTTON. *London: Routledge*, 1941. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xii + 234 *pages; illustrations and sketch-maps.* 12*s* 6*d*

This book on modern Iran is readable and well-timed. After the first fifteen pages it deals with matters historical and economic in the main spiced by opinions about the reactions of the Persians to various accidents of fortune or misfortune. All this is interesting and much of it is educative. The constructiveness of H. I. M. Reza Shah Pahlevi is emphasized and it is clearly stated that Britain has often been regarded as one of Iran's traditional enemies and that the attitude towards Britain has for some time been one of suspicion. Some of the author's views clash with those held by the reviewer, just enough to make the book thoroughly stimulating.

The first fifteen pages, which should be the most valuable ones to geographers, are not nearly so good. Some of the many mis-statements can be excused perhaps as examples of the author's eagerness to compress things within too slender limits. The Zagros is described as the great range sweeping from the Caucasus to die away in the barren plains on the Baluchistan border. The mineral wealth of the Urmiya district is optimistically reported. The country south of Kurdistan is described as a "tangled mass of rock apparently little worn by the weather." A similar remark appears on the next page, although vigorous erosion has bitten into the crust of the earth along the Zagros from Senna to Shiraz sometimes to a depth of a mile. Zardeh Kuh is in Bakhtiari and not in Luristan, and although its landscape is finely jagged its geological structure is hardly so complex as the author would have us believe nor are its rocks so very varied. The rocks which colour the landscape cannot be dismissed as "slate-grey in the north through white to the reddish yellow of the *gach* [white] or

sandstone of the southern hills." Moreover permanent vegetation is known even here for one never goes far without seeing an almond tree, and no one has wandered over the Persian foothills in summer without cursing the thistle and wild barley or spear grass. The fauna he cites belonging to the belt, where the temperature in the shade may be 120° in July, is rather too generous, the mountain sheep, bears, and leopards mostly making off to cooler resorts for the summer. The remarks about Khuzistan on p. 6 are quite incorrect. The *regular* floods of the Karun do not often cause loss of life, nor in general of property. It is surely very rare to find the moisture-bearing south wind set in with the temperature 120° in the shade, for with this wind the temperature drops but the discomfort increases. The Persian Gulf coast is damp and sticky, but it is not the high temperatures of summer that produce the malaria. Where does sugar cane grow on this coast as a trade article and where are its fertile valleys? Does the author think of Shiraz in the coastal belt, or the road along the "Ab-e-dez" as one open to normal traffic? And so one might go on pointing out errors right to the end of the first chapter. There is a second bad patch in the book when the author goes on to write about agriculture, trees, and roads.

Mr. Elwell-Sutton uses a spelling for Persian names which is all his own, and, like most who have to write them, he allows some inconsistencies to appear. But this does not matter very much as, unlike its ancient laws, the local names have changed so much that however one is spelt it will probably have changed before the ink is dry. Most of the photographs illustrating the book are second rate except for the lower picture opposite p. 50. J. V. H.

NORTH AMERICA

CRATER LAKE: the story of its origin. By HOWEL WILLIAMS. *Berkley, California; University of California Press (Camb. Univ. Press)*, 1941. 7½×5 *inches; xii+97 pages; illustrations and sketch-maps.* 10*s* 6*d*

This small book is in two parts; the first is covered by the sub-title and gives a continuous history of the volcanic and glacial phenomena to which the existence and present aspect of the lake and its surroundings are due. The second gives an account of the evidence on which the first is based: it takes the form of a conversation between a guide and a party of tourists who are being shown round. English teachers of geology and physical geography will envy those who have access to a demonstration ground in which such a variety of processes can be illustrated within so small a compass and amidst such beautiful surroundings; but it may be doubted whether the style of the second part, with paragraphs monotonously introduced by such phrases as "a young member of the party asked . . . our guide pointed to . . . how can you tell, said someone," will appeal either to students or to the more intelligent type of adult tourist for whom the book is primarily intended. C. N. B.

CENTRAL AND SOUTH AMERICA

NORTHERN CABALLERO: adventures in the unexplored country of the Amazon. By E. N. MERRYMAN. *London: Robert Hale*, 1941. 8½×5½ *inches; 288 pages; illustrations.* 15*s*

This is a well-produced, fluent volume, dealing chiefly with adventure in supposedly unknown parts of South America. It would have been even more readable had the author been content to rely on one journey, giving a record of day-to-day events; but here, as too often before, the reader is treated in the course of a few hundred pages to what amounts to a recapitulation of most

items in the old South American traveller's box of tricks. The first and, to the reviewer, most acceptable pages deal with an ill-fated attempt to drive sheep across the Andes from Northern Argentina to an American-operated copper-mining camp in Chile, where Mr. Merryman had been employed as "wet nurse" to a camp of mules. Although he had been at the camp for a year, he had not learned its name correctly; for he calls it Portorillos, an obvious mistake for Potrerillos, well-known younger member of the Anaconda group, south of Chuquicamata. The author lost his sheep but found a marvellous silver mine far away in the Andes; won a lottery; and next went off on a search for the hidden treasure of the Inca, complete with ancient map and unreliable guide. Next he spots a gold deposit in a whirlpool, before exploring a river of dark repute, never visited by outsiders. Here, on the Rio das Mortes, the party of four are captured and held prisoner, but after the natives are overawed with fireworks, firearms, and the white man's medicines, we are not surprised to read that Mr. Merryman is made a sub-chief of the tribe and given the great chief's daughter as wife.

The author does not write very seriously; one cannot but suspect that he is, indeed, making merry with his readers. There is but one date in the volume—1930; no maps or index; and the photographs are chiefly of familiar South American racial types. L. E. J.

AUSTRALASIA AND PACIFIC

THE LAST OF THE LOGAN: the true adventures of ROBERT COFFIN mariner in the years 1854–59. Edited by HAROLD W. THOMPSON. *Ithaca: Cornell Univ. Press (London: Milford)*, 1941. 8×5½ *inches; 214 pages; frontispiece.* 12*s*

The author of this book was a sailor in the great days of whaling; he belonged to a common type of adventurous Yankee, but he was a good example of the type, and this is an uncommonly good little book. Robert Coffin was born on a farm in New York State, but he belonged to the great seafaring stock of the Nantucket Coffins. "When I was a young man," he remarks, "my great ambition was to get a thorough education": he signed on for a whaling voyage in order to pay for that education, and got at once more education (in the ways of the world) and less money than he bargained for. The ship was wrecked on Conway or Rapid Reef, south-east of New Caledonia and about 300 miles south-west of the Fiji Islands. The boats reached Ngau safely in 1855, and Coffin spent three-and-a-half months in the Fijis. Afterwards he was nearly four years in Australia before he was brought back to the United States by rumours of civil war.

By no means everyone who had Coffin's experience of adventure would have been capable, as he was, of writing a connected and authentic account of them fifty years later, and of those very few could have commanded a literary style comparable with his. Coffin does not waste a word; he never spoils his pictures by overpainting; and he has a singular gift for making technical operations like those of whaling plain to the layman. The interest of the narrative is maintained all through. As a contribution to knowledge, the book is less important than might be expected for the Fijis, since Coffin's short stay was marked by little or no unusual incident and the descriptions of Fijian life can be paralleled from other books. The development of planting and the "blackbirding" traffic that accompanied it, which began a new era in the Western Pacific, had not yet started. The account of life in New South Wales, first on a farm and afterwards on the goldfields, on the other hand is of real value. Many of the incidental

comments of this intelligent American are of interest; and so far as the reviewer is aware there is no other book describing life on the early New South Wales goldfields in the quiet middle 'fifties, when they were quite overshadowed by Ballarat and Bendigo and the other Victorian fields.

Professor Thompson is a scholarly and understanding editor. The only point at which his editorial policy may be questioned is his decision to omit some criticism of the Fijian missionaries. Melville's 'Typee' is better reading with his criticisms in; and Coffin's prejudice was equally part of the flavour of the man. W. P. M.

BECOMING A KWOMA: teaching and learning in a New Guinea tribe. By J. W. M. WHITING. (Inst. of Human Relations.) *New Haven: Yale Univ. Press* (*London: Milford*), 1941. 9×6 *inches;* xx+226 *pages; illustrations.* $2.75 (16*s* 6*d*)

Mr. Whiting records the results of six months' residence in 1936–37 among the Kwoma, a mountain-dwelling people of the Sepik valley. He is interested in the theory of learning, the way in which social customs are transmitted by one generation to the next, and he employs psychological and functional theories in his interpretation. From this point of view he traces the life of an individual from infancy to adulthood, when the males are admitted to the *nokwi*, the highest grade of the yam cult. In the course of this "socialization," respect for the private property of certain classes of individuals, the right degree of aggressiveness recognized by the clan, and a belief in supernatural monsters, the *marsalai*, are inculcated. To attain to the *nowki*, it is necessary to be a head-hunter, and to be adept in the recognized techniques of gong beating, singing, and dancing; only members of this grade are permitted to plant yams, and they also exercise much influence in council. The author shows that though on occasion *marsalai* may seem to be ineffective, the belief in them persists because it reinforces the status of the yam cult, which is fundamental to the social life. The book thus gives a descriptive account of many aspects of Kwoma life, without attempting to explain the underlying reasons for, or the sources of, the cultural complex. Although a number of incidents are recorded in illustration of the theories, the book is not easy reading, partly because the author approaches his task with much solemnity, partly because he is so anxious to fit everything into a rigid framework. This is exemplified in a statement from his conclusions: "learning only takes place where a person is motivated by a drive to make a response in the presence of cues and gains a reward for so doing."

GENERAL

REMEMBRANCE: an autobiography. By H. J. MASSINGHAM. *London: Batsford*, 1942. $7\frac{1}{2}\times5\frac{1}{2}$ *inches;* viii+152 *pages; illustrations.* 10*s* 6*d*

Readers of Mr. Massingham's earlier books will be acquainted with his opinions on ethnological and archaeological problems, and with the way in which they are linked to his views on rural life and reconstruction. In this eloquent and closely reasoned book they will learn how step by step he came to hold these views. Brought up in advanced Liberal surroundings, he gradually rebelled against the prevalent philosophies and policies of the nineteenth century, being led by his experiences to interpret history as a steady decline from a primitive state of peace into a series of conflicts between acquisitive interests, stimulated by the errors of deductive theorizers. His conversion was primarily due to the influence of the diffusionist school of Elliott Smith and Perry. From his point of view, many historical characters are objects of aversion, ranging from Henry

VIII to nineteenth-century industrialists and T. H. Huxley and Dutch William. Against them he sets the craftsmen and cultivators of the countryside at periods when he believes a true balance had been struck between man and his environment. These opinions, and his reminiscences of well-known contemporaries, give piquancy to his pages. Though his sympathies are largely with the past, he recognizes that the sound agriculture, which he is convinced is necessary for a healthy national life, must be developed from present conditions. It is not necessary to accept as wholeheartedly as the author all the theories here advanced in order to enjoy this revealing autobiography and stimulating commentary on the times.

BY THEIR WORKS: illustrated from the collections in the Buffalo Museum of Science. By H. PHELPS CLAWSON. *Buffalo, New York: Buffalo Society of Natural Sciences*, 1941. $10\frac{1}{2} \times 7$ *inches;* xxii+236 *pages; illustrations.* $4

Many museum curators will feel envious of the Buffalo Society of Natural Sciences, which has been enabled by a grant from the Rockefeller Foundations to enlist the help of specialists from all over the world to examine, advise upon, and arrange the objects in the department of primitive art and to publish the results. Practically half the pages are illustrations, but for the first two chapters, which deal with the Old Stone Age and the Transition Period, these are confined to photographs of casts of such familiar objects as the "Venus of Willendorf." About one-quarter of the book and a single room of the museum is devoted to the Americas; the British reader would have welcomed more detail on this subject, in which the Buffalo Museum has better opportunities for specializing than we have. The book is, in fact, a useful general guide to a part of the Buffalo Museum and will no doubt be welcome to those who can visit it. Some details of the display arrangements are illustrated and described, *e.g.* the Shang and Chou Bronzes have backgrounds of green velvet and yellow labels. There is a good index, but the bibliography gives no particulars other than author and title; on such a subject dates at least are essential C. N. B.

THE MONTHLY RECORD

COASTAL LANDSLIPS OF WEST DORSET

In a short paper in the *Proceedings of the Geologists' Association*, vol. 51, 1940, pt. 3, Miss M. A. Arber gave an account of the Axmouth series of landslips in south-east Devon (*Geogr. J.* 97 (1941) 130); she has followed this up in vol. 52, 1941, pt. 3, with a description of the slipping which occurs in the corresponding strata along the coast of west Dorset. The zone of weakness which in east Devon stretches from Branscombe near Beer Head to the county boundary extends into Dorset as far east as Bridport but with certain differences. In Devon a massive capping of Cretaceous beds rests unconformably on Jurassic clays, when this is undermined by the washing out of the Foxmould Sands and there is a favourable angle of dip, the strata slide bodily seaward. In Dorset there is no such coherent cap and the coastline is more broken so that the landslides are less spectacular. Moreover there is a greater lithological variety and higher exposure of the Liassic beds so that slipping may occur at other horizons. Each limestone outcrop protects the clays below and holds up water which washes out the clays above resulting in a terraced profile.

There has been much loss of land in the Church Cliffs at Lyme Regis, bu the largest of the west Dorset landslips are those on Black Ven and Stone barrow, where the Upper Greensand beds slide over the Liassic clays. Part o the old coast-road over Black Ven has now been completely carried away, an on Stonebarrow especially the subsidences have left an inland scarp separate from the seaward cliffs by a tumbled undercliff.

Contrasted with these, very little slipping has occurred on Golden Ca Down Cliff, and Doghouse Hill farther east, where the higher beds are a sandy and so equally permeable; or to the east of the big fault at Watton Cli near Bridport, where the lithology of the beds is very uniform.

STONAR AND THE WANTSUM CHANNEL

In the *Journal* for March we had a note on the physiography of Stonar and th Wantsum Channel by F. W. Hardman and W. P. D. Stebbing (Part I *Archaeologia Cantiana* 53 (1942) 62). This has been followed by a note on the histor (Part II *Archaeologia Cantiana* 54 (1942) 41–53). The historic period has bee dominated by the deterioration of the northern, Ebbsfleet, entrance of th Wantsum Channel. Early in the fifth century the last Roman legions harboure there. Little information is available for the succeeding one hundred and fift years, but in the seventh century grants of land were made to the Convent a Minster. The Abbess claimed dues from traffic passing through the Ebbsflee entrance and probably helped to keep it open until the convent was sacked b the Danes in 978. The Ebbsfleet and Sandwich entrances then came under th control of two rival monasteries at Canterbury, and much of the story of th decay of the entrances can be deduced from the records of the rivalries of thes two institutions, and of their eventual enforced loss of rights and customs b Edward III in 1364 in exchange for grants of land. In 1052 the channel wa still open, for Harold sailed that way from Dover to London. The closing of th more direct and commodious Ebbsfleet channel was a disaster, and the windin Sandwich channel then began to silt up even more rapidly. The Sandwich foll blamed the abbots' inning or reclaiming operations both for the silting and fo the subsequent flooding about which complaints were made from the thirteenth century onwards. Severe inundations occurred in 1365 and spasmodic flooding has continued to this day.

PAN-AMERICAN HIGHWAY SYSTEM

By the courtesy of the Chief of the Inter-American Regional Office, we received in February last from the Federal Works Agency Public Roads Administration, Washington, an important set of blue prints and reports showing the state of the Pan-American Highway System, the northern map corrected to January 1941 and the southern to August 1940; and we hope to prepare from this material for publication in the *Journal* a summary of the present condition of this very important and interesting project. Meanwhile we take leave to extract from a letter of Major Paul Pleiss, a Fellow of the Society, some notes of a journey by car which he made over large sections of the route about a year ago. Accompanying his letter were two maps produced from the larger plans and the southern sheet showing further work done by Peru up to January 1942. Major Pleiss writes: "By referring to the condition chart at the left you will see that there are a considerable number of gaps; and while trails are shown, actually the way can be considered impassable for a motor car, although at least one car has made the trip through Central America. The worst stretches are in Mexico south of Oaxaca and to the border of Guatemala. Nicaragua, except for the area near the capital, consists of bullock-cart trails with very deep

ruts; Costa Rica is passable to the capital, but beyond difficult even for burros. Panama has a road from the western border to the canal and about 25 miles beyond, and after there is nothing but impassable and dangerous jungle. From the border of Colombia I am afraid it will be years before anything is done, as there are two river basins about 100 miles wide which will call for a causeway or a ferry around from Panama to Turbo on the Gulf of Darien.

"We did not attempt the Central American route, but started at La Guàjra, Venezuela, to Bogota, Medillon, Quito, and so to Guayaquil. That is an all-weather road but extremely mountainous all of the way, one pass of 14,000 feet and many others from 10,000 to 13,000. The road is gravel and rough but passable. From San Juan to Guayaquil the descent from about 12,000 feet to sea-level was most difficult and was probably the most hazardous part of the journey. At present there is no road or trail to the border of Peru, so it was necessary to ship the car 100 miles to Tallara in Peru. Peru has a road, asphalt or metalled, along its coast from border to border. Instead of continuing south from Lima we chose to cut west and attempt the so-called Carretera Central to Cuzco and La Paz. To get up on to the tableland we crossed the Anticona pass at 16,800 feet and remained over 10,000 feet for nearly four weeks. The road has not yet been improved, because of land slides and mud it was most difficult. In spots we felt that no improvements had been made since it served as the royal road of the Incas. We returned to the coast *via* Arequipa and then south through the wastes of Chile to Santiago. There is a semblance of road for the 1200 miles, but it is cut up and rough and almost the entire way a wash-board. No car can stand up, and here we had our first mechanical trouble. The vibration caused by the rough road and the necessity of trying to synchronise one's speed to minimize vibration eventually causes fatigue of moving parts.

"From Santiago the Pan-American Highway is to go east to Buenos Aires. Except for the pass over the Andes at Christo Redentor it is not difficult, and the average time taken is only two days. Rather than take the conventional route, and having a yearning to cross Patagonia, we continued on south from Santiago and again crossed the Andes north of Bariloche, then south along the foothills of the Andes. South of Lago Buenos Aires we cut southeastward across the Pampas to St. Julien on the Atlantic, south from there to Gallegos, and finally to Magellanes on the Strait. Returning from there to Buenos Aires was comparatively easy on a fair road, 3000 miles in eight days. From Buenos Aires to the border of Brazil under normal conditions is not difficult, but it includes driving for about 800 miles along the beach, and that is highly tricky. The map shows an interior route to Puerto Alegre, but this is only a project; therefore the beach driving. North from Puerto Alegre is a fair road, but for us impossible because of the floods this spring in that area, so we shipped to Santos and then drove south to the beginning of the flooded area at Curytiba, then north again to Rio and then home by boat. We covered a little over 13,000 miles during a period of five months of unremitting toil. You will note on the map a road from La Paz to Buenos Aires; during the dry season this is quite practicable but impossible in the rainy season."

THE WALLS OF JERUSALEM

In the last number of the *Quarterly of the Department of Antiquities* in Jerusalem (10 (1942) 195) there is a brief note about some recent discoveries which have been made to the north of the city. The foundations of a city wall 4 m. thick with two projecting towers have been found on the same line as a series of wall fragments which were excavated by Dr. Sukenik and Dr. Mayer in 1925–28. These earlier finds were identified by their discoverers with the

Third Wall of Jerusalem which was built by Agrippa according to a famou chapter by Josephus. The identification was called in question by some of th older archaeologists in Jerusalem who argued that the Third Wall of Josephu was on the line of the present north wall. The new finds include a tower 20 m. wide, projecting 8 m. from the face of the wall above the Kidron Valley, and they carry the total length over which the wall has been traced to 765 m. It wa obviously a much more imposing work than the critics of the earlier finds wer disposed to admit, and few will now hesitate to accept it as Agrippa's wall. Th identification is strengthened by the recent work of the Director of Antiquities Mr. Hamilton, on the present north wall of the city. This work was carried ou in 1937–38 and published two years ago in the first number of the same volume A series of soundings then made against the Damascus gate and in the neigh bourhood of Herod's gate yielded conclusive evidence that the earliest wall o this line was built towards the end of the third or the beginning of the fourth century, some time, that is, after the foundation of Aelia by Hadrian on th ruins of Jerusalem in the second century A.D.

The new discoveries have been made in an excavation conducted jointly by th Hebrew University and the American School of Oriental Research in Jerusalem they have not yet been fully published, so far as we are aware, but the authoritative note in the *Quarterly* satisfies us that one of the bitterest controversies con nected with the topography of Jerusalem may now be regarded as closed. It may, perhaps, be well to add that the solution of the Third Wall question doe not affect in any way the question of the authenticity of the site of the Hol Sepulchre with which it has often been mixed up.

ROCKS OF FALCON ISLAND

In the *Journal* for July 1941 (98.33) we published a note by Mr. F. H Charlton, Director of Lands and Surveys, on a visit to Falcon Island made i November 1940 by Sir Harry Luke, Governor of Fiji, and members of hi staff. This volcanic island, 50 nautical miles north-west of Nukualofa, capita of Tonga, varies much in height and shape, being a breaking reef in 1898, 4 feet high in 1930, and only 20–30 feet in 1940.

We have now received from His Excellency two rock specimens collected o his visit, which we have submitted to the Natural History Museum, where the were sliced and examined by Mr. S. E. Ellis, of the Mineral Department. H reports that one is a minutely vesicular lava, an andesite basalt with irregula vesicles up to 0·2 mm. in diameter, with felspar phenocrysts up to 1 mm., an some of augite. The matrix has abundant grains of pyroxene, with magneti and a little brown glass. The second specimen is a tuff containing angul fragments of black lava up to 10 mm. with more glass and less phenocrysts.

These rocks are similar to others from the Fiji Islands, and very like tw specimens from Varua Levu, collected and presented to the British Museu in 1883 by Surgeon H. B. Guppy, of H.M.S. *Lark*. Since we learn from Dr L. I. Spencer that these specimens would be a welcome addition to the roc collections of the British Museum we have proposed that they shall be slice into halves, and hope that one part of each will be shown in our Museum short

OBITUARY

CAPTAIN HUBERT BERKELEY, I.S.O., J.P.

Captain Hubert Berkeley, who died on 27 April 1942, entered the Civil Service of Perak in 1886, where he was District Officer from 1891 until his retirement in 1926. His knowledge of the topography of Upper Perak and of the adjacent countries and their inhabitants was of great value to the Government, especially in delimiting the Siam–Upper Perak boundary in 1909. He knew the Malays intimately, protected them from commercial interests, and kept open house for them at his headquarters at Grik. After retiring he lived at Droitwich, where he was Chairman of the County Bench. He had been a Fellow of our Society since 1923.

GEOFFREY MILNE, M.Sc., F.I.C.

Geoffrey Milne, who died suddenly on January 16, had been the soil specialist of the Amani Research Station, Tanganyika, since 1930. After service in the last war and a successful career at Leeds University, he applied himself to the study of agricultural chemistry. At Amani he initiated research in the study of the soils and related problems of East Africa, which resulted in the first provisional soil map of that region published in 1936, and in many papers which advanced understanding of the basis of future progress. To keep abreast of contemporary developments in his science he had travelled extensively in Africa, the United States, and West Indies. His work was widely appreciated by fellow scientists in related subjects, and in 1940, at the request of the Pasture Research Conference at Nairobi, he became chairman of a committee to draft a vegetation map of East Africa. At the time of his death he was about to take up the post of Scientific Secretary to the East African Supplies Board. His death at the age of forty-four was a severe loss to scientific research in Africa. He had been a Fellow of our Society since 1935.

MEETINGS: SESSION 1941–42

Twenty-eighth Meeting, 1 June 1942. Geographical films: The construction of the Boulder Dam, by permission of the Imperial Institute, with a commentary by Captain W. N. McClean. Through Madagascar: kodachrome film by Mrs. Murray Chapman

Twenty-ninth Meeting, 8 June 1942. The President in the Chair

Elections: 2/Lieut. G. H. S. Behrend, R.A.C.; John Orry Cowin; Miss Helen N. Davidson, B.Sc.; John Henry Essex; Miss Doris Gray, B.A.; Major W. B. Gunnell, R.E., M.INST.R.A.; Rev. W. Dudlick John, B.A.; Mrs. Kathleen Rogers, B.A.; A. E. Thomas; Squadron-Leader J. L. Hillary, R.A.F.; K. C. Orsborn, B.Sc.

Paper: The United States Antarctic Expedition, 1939–41. By Lieut. Dana Bailey

Annual General Meeting, 22 June 1942. The President, The Rt. Hon. Sir George Clerk, in the Chair

The HON. SECRETARY (Mr. W. L. Sclater) read the Minutes of the Annual Meeting held on 23 June 1941, which were confirmed and signed by the President

Elections: Miss Monica M. Cole; W. C. W. James; G. Sydney Warren, M.B.E., J.P.

The PRESIDENT: The two Gold Medals graciously given annually by His Majesty on the recommendation of the Council are of equal distinction. The Patron's Medal bears the effigy of the reigning sovereign, the Founder's Medal that of H.M. King William IV. The medals cannot be struck until the end of the war, and at this presentation I shall have the pleasure of asking the representatives of the recipients to transmit to them certificates signed by the Keeper of His Majesty's Privy Purse. H.M. the King has approved this year the award of the Patron's Medal to Mr. Owen Lattimore, and of the Founder's Medal to Miss Freya Stark.

Mr. Owen Lattimore has a long and extensive experience of Central Asia, particularly of the great territories to the north and west of China. After several years in China, during which he learnt the Chinese vernacular, he carried out in 1926 and 1927 an important journey along little-known caravan routes from Pekin to India, being accompanied on the latter part by his wife. In later years he has continued to travel widely in Manchuria and Mongolia. At first he was mainly interested in the trade of the interior, and modestly described himself as "no learned geographer"; his interests however gradually concentrated upon the history and geography of this important march land of inner Asia, and he has studied carefully the interrelations of these sciences, particularly in regard to the nomadic, pastoral tribes, the expanding Chinese colonists, and modern industrialism. These journeys and their results Mr. Lattimore has described in papers to our Society and in a number of books, blending the results of first-hand observation and of scholarly research. The most notable is his 'Inner Asian frontiers of China' published in 1940, a detailed treatment of a complex subject of great import for the future. He is now in the United States, having been lately adviser to General Chiang Kai Shek. I will therefore ask Mr. Ware A. Adams, Second Secretary of the American Embassy, to accept this certificate on his behalf, and with it to convey to Mr. Lattimore our high appreciation of his geographical achievements.

Mr. WARE A. ADAMS (Second Secretary, American Embassy): I thank you, sir, on behalf of Mr. Owen Lattimore. The American Ambassador will send this award to him immediately, and I am sure no honour could have pleased Mr. Lattimore more than one bestowed by the Royal Geographical Society.

The PRESIDENT: Miss Freya Stark is so well known both to our Fellows and to all appreciative of modern travel literature, that there is little need for me to recite in detail the grounds of the Council's recommendation to His Majesty. Her journeys have taken her through the valleys of Luristan, and into Southern Arabia from Mukalla to the cities of Shibam and Tarim. Especially notable was her journey through the partially unexplored country between Hureidha in the Wadi Hadhramaut to the sea. Her success has been due to her courage, determination, and, above all, to her gift for making friends with all types and conditions of peoples. To these gifts she adds the power of recording vividly and sympathetically incidents of travel, the daily social life, and the geographical aspects of the countries with which her name is now associated. Her books, particularly 'The Valleys of the Assassins' and 'The southern gates of Arabia,'

have delighted, and will continue to delight, great numbers of readers. Miss Stark is now in Baghdad, and I shall ask Admiral Sir William Goodenough to accept this certificate on her behalf.

Admiral Sir WILLIAM GOODENOUGH: In the name of Miss Freya Stark I have to thank you, sir, and the Council for having made this recommendation to His Majesty. I have received a letter from Miss Stark since she knew that the award had been made in which she writes—beautifully, of course—her great appreciation of this high honour which has been done her. On her behalf and in her name I would say what she would have said had she been here: that she will make every effort to extend her knowledge and the description of it to that branch of geographical science which is represented by this Society.

The PRESIDENT: The Victoria Medal, awarded by the Council from time to time for distinguished contributions to geographical science, is given this year to Dr. Harold Jeffreys for his researches in the physics of the Earth. Geographers describe and measure its surface features, and when they are assured by geologists that the highest mountains in the world are relatively young, they must inquire what are the forces which have raised the Alps and the Himalaya, and how the crust of the Earth can support their immense mass. When geographers have mapped the Earth as it is, they are naturally interested by suggestions that the continents are drifting and that the poles themselves are not fixed; but, whatever may be their views on these propositions, they have themselves no sufficient means of criticism. That requires a mathematical physicist of the first rank, and such a man is to-day's medallist. His celebrated book with the simple title 'The Earth' covers the whole range of geophysics: the origin and age of the Earth; its thermal history; the all-important radio-activity of its upper layers; its bodily tides and internal friction; the possible variation of climate; the constitution of its interior revealed by earthquake records; its strength; and its contraction by cooling: all leading up to the origin of its surface features. Geographers owe to Dr. Jeffreys a great debt. If they cannot hope to follow much of his mathematics, they are under his guidance able to distinguish between propositions that are harmonious with a consistent physical theory, and those which are in conflict.

Dr. HAROLD JEFFREYS: I am much honoured, sir, by the award to me of the Victoria Medal of the Royal Geographical Society. I thank you for your kind remarks. I am particularly proud to have received a medal once awarded to Sir George Darwin, whose work has been to so large an extent the foundation of my own.

The PRESIDENT: The Murchison Grant has been awarded by the Council to Dr. S. W. Wooldridge and Flight-Lieut. David Linton jointly for their researches upon the geomorphology of Southern England. The results of this work have been collected in their "Structure, surface, and drainage in south-east England," published by the Institute of British Geographers in 1939. They have shown the problem to be much more complex than was generally supposed, and have demolished a number of widely accepted generalizations, so that their work must form the starting-point for future research. In developing their study of surface configuration they have not neglected its relationship to human settlement, and this aspect has been further developed by Dr. Wooldridge in other papers, including one read to our Society jointly with Mr. Smetham on the historical geography of Essex and Hertfordshire.

Dr. S. W. WOOLDRIDGE: Mr. President, may I express the very deep appreciation that Flight-Lieut. Linton and I feel for the honour done to us in this award and add that, conscious of the grave omissions and shortcomings of the work that we have attempted to do, we shall now have this encouragement for

continuing it—work which now seems to be separated from us by a long dist of time, even if it is only three years of war. We value the appreciation of w we have done.

Flight-Lieut. DAVID LINTON: May I, Mr. President, add to what Dr. W dridge has said my own very warm appreciation of the h[illegible] which has b done to both of us in this award. When Dr. Wooldridge [illegible] I came so fa our work as to venture on publication I think we regarded i[illegible]s an *interim* rep This will be an encouragement to continue the good work

The PRESIDENT: Surgeon-Commander G. Murray Le[illegible]K, R.N., as Medi Officer and Zoologist, accompanied Captain Scott's last expedition to Antarctic in the years 1910–13. Convinced of the value of inculcating the h of self-reliance in young men, and at the same time encouraging the love adventure, he founded in 1932 the Public Schools' Exploring Society. Un his leadership several expeditions have been carried out successfully in N foundland and Northern Finland; many of us will recall the film shown h dealing with a skiing journey in Lapland. It is for this work in stimulating directing the spirit of adventure that the Council have awarded him the Grant.

Surgeon-Commander MURRAY LEVICK, R.N.: I thank you very much, sir, the great honour which you have conferred upon me in giving me the Grant. At the same time, I cannot let this opportunity pass without sa how much the success of the Public Schools' Exploring Society owes to the h work and cooperation of my wife, who has been Hon. Secretary since Society's inception.

The PRESIDENT: Lieut.-Commander L. C. HILL, R.N.R., to whom the Co have awarded the Gill Memorial, was for eight years an executive officer i Royal Research Ship *Discovery II*, and commanded her on her last two missions in the Antarctic, 1935–39. In this key post his successful navig and his outstanding mastery in handling the ship in the difficult conditio the polar seas contributed in great measure to the success of the scie observations. He also planned and carried out valuable surveys of the S Shetland Islands.

Lieut.-Commander L. C. HILL, R.N.R.: I am deeply grateful to you, sir, the honour you have conferred upon me and hope that in future years I m permitted to continue my services to geography.

The PRESIDENT then delivered the Presidential Address which is print pp. 1–4.

Visitors having withdrawn, the PRESIDENT appointed Major A. J. A. Do and Major N. E. Odell to act as scrutineers of the ballot for the Council Officers for the ensuing year.

The PRESIDENT submitted the Annual Report of the Council, which adopted without comment.

The scrutineers informed the President that the candidates proposed b Council had been elected (see list, p. ii).

Admiral Sir WILLIAM GOODENOUGH: Before you close the meeting, President, there is one remark I would like to make. I know I am out of o but it is a dis-order the Fellows will forgive, and one I hope you also forgive. We wish, I am sure, to thank you for your presidency during the year. You have been patient with the old, like myself, encouraging t young, and courteous to all.

The Meeting then terminated.